Urban Form Systems in Physical Planning

A Case Study of Cumbernauld

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Thesis presented for the Degree of
Doctor of Philosophy of the University of
Edinburgh, Faculty of Social Sciences, Department
of Urban Design and Regional Planning
1970

To my mother

Grace Louise

and

In memory of my father

Lewis B. Waters

PREFACE

This study is the result of the writer's belief that urban form - the shape of the urban environment - is an important consideration in planning and design. The reasons for this belief and the resulting study and conclusions make up the body of this thesis. It is divided into three sections. Section I is made up of background studies in four chapters. Chapter I examines conditions of urban form in the world and Britain. Chapter II discusses the meaning and purpose of urban form. Chapter III sets out four study hypotheses based on a concept of urban forms as systems. Chapter IV discusses the reasons for choosing Cumbernauld new town as a case study to test the hypotheses.

Section II sets out the formats and descriptive results of the Design Surveys used to test the hypotheses. Chapter V deals with the visual survey. Chapter VI deals with the household survey. Section III sets out the validation of surveys and hypotheses and some implications of the study findings. Chapter VII deals first with the surveys' validity and measured survey variables. It then discusses the validity of the study hypotheses in separate successive chapter sections. Chapter VIII discusses some implications of the study findings for the process, application and theory of urban design.

Two features of the text are intended to ease the reading and comprehension of the material. First, all chapters have an introductory paragraph setting out general contents and a summary which sets out the general conclusions of these contents. Often where there are sections of a chapter dealing with separate subjects these

are summarised at the end of the section. Introductions and summaries are marked in the Table of Contents. It is suggested that the reader look at these and Chapter VIII first for an overview of the study. The second feature is a cross-referencing system. Each paragraph in the main text and the appendices is numbered with 1) the chapter or appendix number, 2) the chapter or appendix section number(s), 3) the paragraph number. Thus the number 6.2.1.3 refers to Chapter VI, section 2, sub-section 1, paragraph 3. Number A.3.1.2 refers to Appendix 3, section 1, paragraph 2. Tables and maps have a similar reference system. These references occur in the text when there is a particular correspondence between two paragraph or section subjects. Town and local area maps and overlays are loose in a separate folder. Base maps are prints. Overlays are transparencies.

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ACKNOWLEDGEMENTS

The writer would like to acknowledge the help of several units which made facilities, services and, often, personal help available on material pertaining to this study.

The Department of Urban Design and Regional Planning, University of Edinburgh, under the direction of Professor Percy Johnson-Marshall

The Architectural Research Unit, University of Edinburgh, under the direction of Charles Robertson

The Planning Research Unit, University of Edinburgh, under the direction of Richard Bigwood

The Cumbernauld Development Corporation, Cumbernauld, Scotland, Chairman: Dame Jean Roberts, D.B.E.,D.L.,J.P.; General Manager: G.R.B. MacGill, C.B.E.,C.A.,F.I.M.T.A.

These volumes are probably destined to a fairly static existence on a library shelf. Neither writer nor contributors will suffer from an overexposure of interest or recognition. To the writer, however, this work is something quite personal, and those people who contributed to the study are due much more than an acknowledgement on a typed page. In most cases the amount of help, understanding and patience shown cannot be repayed. Simple words will sound extremely inadequate, but "Thank you" especially to:

Derek Peare
Aileen Harper
Mayer Hillman
Jackie Harding

The students I have taught and learned from at the Edinburgh College of Art, Department of Town and Country Planning and The Glasgow School of Art, Department of Planning

and to:

Heather Brown
Peter Rodger
Jim Johnston
Rob Leitch
Elspeth Norris
Derek Lyddon
John Ross
Gary Melnicove
Bob Martin

Jean Davidson
Glyn Riddell
Hugh Dobbins
Mr. Cook
Mr. Brown

Ann Abbott
David Stewart
Rosemary Bisset
Bob Caldwell
John Leonard

ABSTRACT OF THESIS

This study is the result of the writer's belief that urban form - the shape of the urban environment - is an important consideration in planning and design.

Chapter I discusses the growing complexity of an urban environment that promises to be the dominant living condition for a majority of the world population within the next thirty years. Chapter II proposes that urban form will therefore be increasingly important in imparting information to man about the working of this environment. Chapter III suggests that urban forms may be systemic by design, and by physical relationship but that the correct use of systems actually depends upon their appropriateness for the activities and perception of the human users. Chapter IV proposes to test this thesis in Cumbernauld new town since it offers physical conditions both sympathetic and adverse to the thesis.

In Chapter V a visual survey of the town finds that while its road structure has strong systemic forms, the footpath and local area forms are relatively weak and disorganised. In Chapter VI a household survey finds that inhabitants can readily identify both local areas, which contain a majority of activities and important places, and linear routes to town areas, which are to places less important and less used than local areas. In Chapter VII a series of statistical and descriptive tests suggest that the forms and activities of systems are highly related in many respects and that the use, appeal and importance of places in these systems often are directly attributable to the physical and visual relationships of their concomitant forms. Chapter VIII discusses some implications

of systemic form theory by assessing the findings and analyses of the survey results. These discussions are set forth under three headings: Process Implications, Practical Implications, Theoretical Implications.

"Where there is no vision, the people perish."

SECTION 1

I.1 This section examines the growth and form of urbanization in general contexts, primarily with regard to population growth - to the increase in size of world and urban populations and the general forms of urban environments at different stages of this increase. New towns as a distinctive form of urban environment are examined in Britain - the most highly urbanized and industrialized country in the world. The increase in urbanization in all world regions, especially those with the majority of the world's population, make urban programmes such as Britain's particularly important. Usually urban form is regarded as an end-product of the planning and design processes - at the least something which 'just happens'; at the most something to be manipulated for aesthetic enjoyment. But urban form is here regarded as an influence on man's behaviour. No matter what the scale, from the individual object to the world region, form - the appearance of a thing or a group - is a basic key to meaning.

II.2 As a dwelling can not be regarded in isolation from its surroundings, nor the individual from society, so the single form can not be regarded as separate from adjoining forms. Its 'function' is to express both its individual purpose, and those of its relations to the systems of which it is a part. Further, both of these expressions, individual and systemic, must be clear to the human user or an ultimate purpose of form is not accomplished. The tenets of hypotheses relating to this viewpoint can best be tested by response from inhabitants of an urban environment. The most important type of environment is that which is still to be built if the urban conditions of this planet in the next 30 years are to be transformed from possible chaos to useful order. Today's new communities are first tentative steps toward this order.

CHAPTER I

1.0 This chapter examines the growth of urban population as an indicator of the changing form of the urban environment. It examines Britain as a country which most embodies the symptoms of urbanization and briefly surveys proposals embodying the British new towns as one solution to some of the problems of urban structures.

The Growth and Form of Urbanization

1.1.0 Ever since man started gathering into communities some 12,000 years ago he has made problems for himself by complicating the structure of his environment. The growth and disposition of urban population are generally indicative of these problems. Elridge has described the process of urbanization as having two component parts: 1) "the multiplication of points of concentration", and 2) "the increase in the size of individual concentrations".[1] This description certainly fits the history of urban development so far as it is known. The initial proliferation of man's first villages was followed by the growth of a few of these settlements into larger cities. This was in turn followed by a second proliferation of smaller industrial settlements many of which grew - and are growing - into large metropolises. But Elridge's description is not sufficient to explain what is happening to today's urban environment and what could happen to it in the near future.

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[1] Hope Tisdale Elridge, "The Process of Urbanization" in Demographic Analysis; J.J. Spengler and O.D. Duncan (eds.), Glencoe, Illinois: Glencoe Free Press, 1956, pp.338-343.

1.1.1 In 1960 the world population was approximately 3,000 million, 1,020 million (34%) of which were urban.[1] By the year 2000 the world population may be 7,000 million, 3,850 million (55%) of which may be urban.[2] In other words, in 30 years the world urban population will exceed the total world population in 1960. This means a growth of 380% in the urban population as compared to a 240% increase in world population (Figure 1.1).

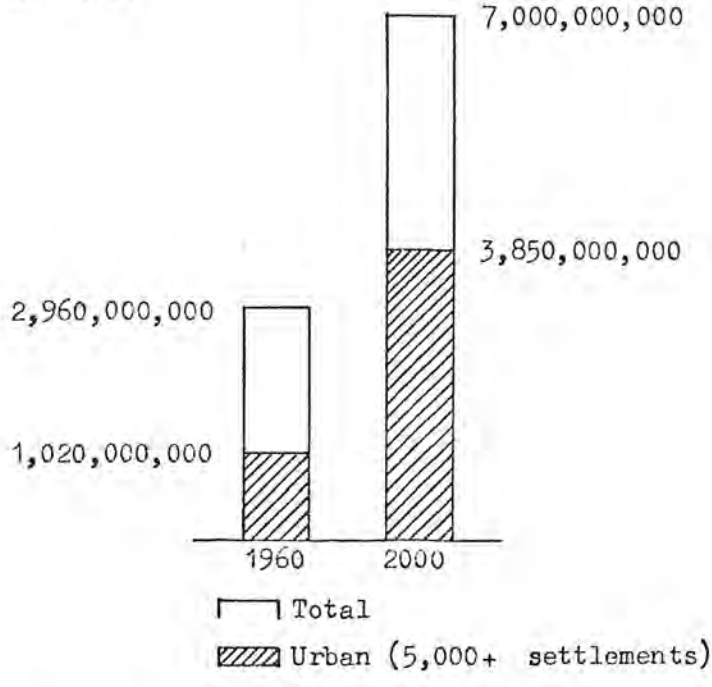

Figure1.1: The Growth of World and World Urban Population, 1960-2000

Sources : See footnotes 1, 2.

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1 United Nations Statistical Office of the Department of Economic and Social Affairs, Demographic Yearbook. New York: No. 14, p.7; Alfred Sauvy, Fertility and Survival - Population Problems from Malthus to Mao Tse-Tung. (Translation to English by Christine Brooke-Rose) London: Chatto and Windus, 1961 pp.19-22; Philip M. Hauser and Leo F. Schnore (eds.), The Study of Urbanization, New York: John Wiley and Sons, Inc., 1965, p.522.

2 Homer Hoyt, World Urbanization - Expanding Population in a Shrinking World. Washington: Urban Land Institute, Technical Bulletin No. 43, 1962, pp.7, 49; Hauser and Schnore (eds.), op. cit., pp. 7, 13, 14.

1.1.2 This rate of urbanization is a relatively recent development, however. For the first 11,000 years of civilization both world and urban populations grew at slow although not necessarily steady rates. Gordon Childe, the British archaeologist, has surmised that if reliable statistics were available there would be a number of "conspicuous kinks" in the population graph, each reflecting an urban revolution of sorts.[1] Extrapolation from Gordon Childe's work and that which has followed indicates that four major urban revolutions have each produced a distinctive size and type of urban form. The neolithic revolution produced scattered villages which were usually limited to 200-600 persons by their transitory nature.[2] The second urban revolution produced what Sjoberg has termed the pre-industrial city. These were few in number and limited to 20,000-100,000 people by their dependence on the produce of the surrounding country and their crude but effective technology.[3] The Industrial Revolution effectively broke the total dependence of the city on the adjacent country.[4] At first it caused a proliferation of small towns which often grew up

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1 V. Gordon Childe, What Happened in History. Penguin, 1942, reprinted, 1965, pp.29-32.

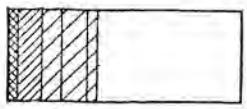
2 Ibid., pp.55-77; Hauser and Schnore (eds.), op. cit., pp.520-826; Kingsley Davis, "The Urbanization of the Human Population", and Gideon Sjoberg, "The Origin and Evolution of Cities", Scientific American. Vol. 213, No. 3, Sept., 1965; Wolf Schneider, Babylon is Everywhere. London: Hodder and Stoughton Ltd., (Translated into English by Sammet and Oldenburg) 1963, pp.25-32.

3 Sjoberg, The Pre-Industrial City. London: Collier-MacMillan Ltd., 1966; Emrys Jones, Towns and Cities. London: Oxford University Press, pp.19-22, 39, 40; Gordon Childe, op. cit., pp.40-75; Lewis Mumford, The City in History. Penguin, 1961, pp. 361, 385; Schneider, op. cit., p. 128.

4 Davis, op. cit., p. 43; Sjoberg, "The Origin and Evolution of Cities"; op. cit., pp. 57-63; Patrick Geddes, Cities in Evolution. London: Williams and Norgate, Ltd. (orig. 1915), 1949; Mumford, op. cit., pp. 395-404; Walter Creese, The Search for Environment. New Haven: Yale University Press, 1966, pp. 30-35.

around a single industry located close to the sources of its raw materials.[1] Later, with the advent of steam, electric power and powered transport, many towns grew into large industrial cities of 1,000,000 and more people.[2] About 300 years ago, at the beginning of the industrial revolution, total population began to grow at an even faster rate. During the last 150 years the urban population increased 26 times while the world population increased only $2^{1/2}$ times.[3]

1.1.3 Projected urban growth indicates a much larger number of people living in larger, more complex communities. In 1950 30% of the world's population were living in places of 5,000 or more.[4] Another 4% lived in places of 2,000-5,000 people.[5] Only 9% of the population, however, were living in places of 100,000-1,000,000 and only 4% in places of over 1,000,000 [6] (Figure 1.2). Between 1950 and



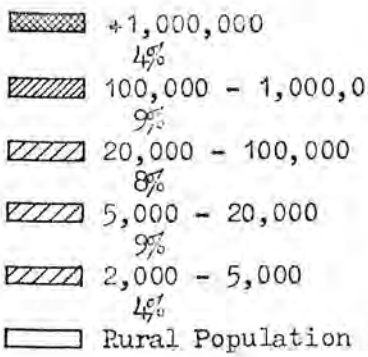


Figure 1.2: Urban Population by Settlement Size as % of World Population 1950

Source: The Study of Urbanization. p.7.
United Nations Demographic Yearbook, 1958.

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1 Geddes, op. cit., pp.22-32.

2 Adna Ferrin Weber, The Growth of Cities in the Nineteenth Century. Ithaca, New York: Cornell University Press (orig. 1899), 1963.

3 Hauser and Schnore (eds.), op. cit., p.522.

4 Ibid., p.522. 5 Ibid., p.522. 6 Ibid., p.522; UNESCO, op. cit., p.7.

1960 the percentage of urban population increased only slightly but the structure of this population altered. While the number of persons living in places of 2,000-100,000 declined in both relative and absolute terms the percentage living in places of 100,000-1,000,000 increased slightly and the percentage living in places of over 1,000,000 increased markedly.[1] Projections of the population structure for the years 1975 and 2000 show significant increases in the population living in cities of 100,000-1,000,000 and cities of over 1,000,000. There will be a slight increase in the percentage of population of smaller communities by 1975, but by 2000 this will have dropped to below the 1960 figure.[2] By the year 2000 55% of the population will be urban, 21.7% will be living in cities of 100,000-1,000,000 and 20.5% will be living in cities of over 1,000,000 (Figure 1.3).

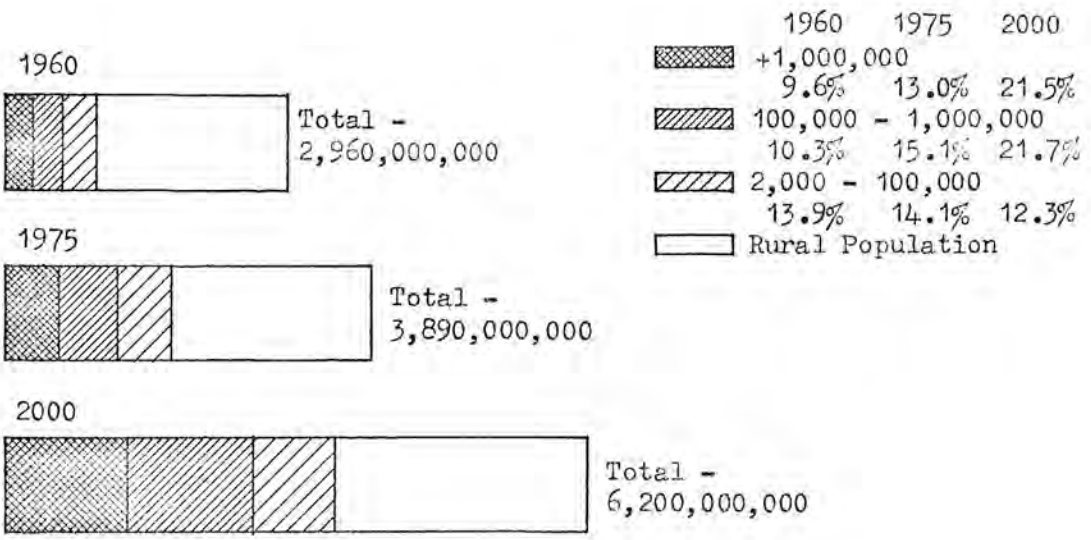

Figure 1.3: Urban Population by Settlement Size as % of World Population in 1960, 1975 and 2000

Source: World Urbanization - Expanding Population in a Shrinking World. Table XVII, p.49.

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1 Homer Hoyt, op. cit., p.49.

2 Ibid.

These last figures are a portent of the technological revolution. The technological city, already evident in advanced industrial countries, is based on an accelerating technology affecting communications, production and distribution, and leisure.[1] It seems unlimited in size and is thought by some not to be a city at all.[2]

1.1.4 It is likely that the majority of this urban growth will occur in areas which contain the major part of the world's population. At present the most highly urbanized countries, with the exception of Scandinavia, Switzerland and several South American countries, are also the most highly industrialized. Hall has termed these "the advanced industrial countries"[3]. Yet, as Jones points out, "regions of extreme industrialization are few and restricted"[4]. In fact, the population of Hall's industrial countries is only 26% of the world total[5]. Jones notes that "the rate of urbanization is decreasing a little in the older industrial countries but hardly enough to disturb the general upward trend. Urbanization is now beginning to affect the peasant agricultural people who form the bulk of the

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1 Z. Brzezinski, "America in the Technotronic Era", Encounter. Jan., 1968; Peter Drucker, The Age of Discontinuity: Guidelines to our Changing Society. New York: Harper and Row, 1969.

2 Hans Blumenfeld, "The Modern Metropolis", Scientific American. Vol. 213, No. 3, Sept., 1965, p.64; E.A. Gutkind, The Expanding Environment. London: The Freedom Press, 1953, p.39.

3 Peter Hall, The World Cities. London: World University Library, 1966, p.14.

4 Emrys Jones, op. cit., p.13.

5 UNESCO, Statistical Yearbook, op. cit. These totals are taken for 16 countries named by Hall.

world's population".[1] The developing world regions contain over 70% of the world's population. South and Middle America have fairly high percentages of urban population but in Asia and Africa, which have the majority of world population, the percentages are quite low. Even so, the total number of urban population in the developing world regions is higher than that of the developed regions[2] and is growing at much faster rates[3] (Figure 1.4).

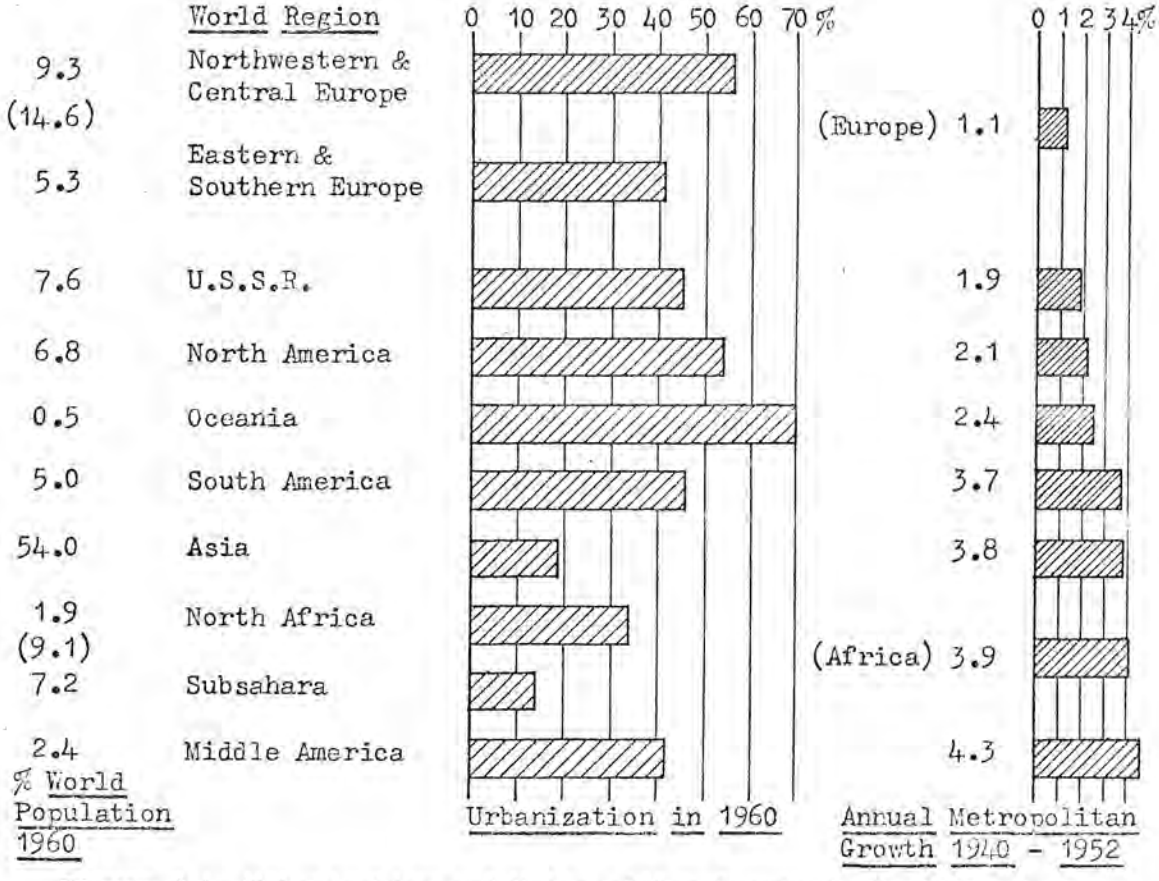

Figure 1.4: Urbanization and Metropolitan Growth in World Regions

Sources: Davis, p.85; Gibbs and Schnore, pp.160-170 (see below).

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1 Jones, op. cit., p.35.

2 Kingsley Davis, op. cit., p.43.

3 Jack F. Gibbs and Leo F. Schnore, "Metropolitan Growth: An International Study", The American Journal of Sociology. Vol.66, July, 1960, pp.160-170.

1.1.5 In the developing regions most of the population still live in villages which are closely tied to the land.[1] This does not mean, however, that there are not large cities in these areas. Of the world's 97 cities with over 1,000,000 inhabitants in 1966, 54 were in developing regions.[2] Davis has pointed out that the growth of large cities in developing regions is not always due to urbanization. Many large cities, particularly those of Asia, are growing almost entirely by natural increase rather than rural-urban migration.[3] Davis forecasts that urbanization, when it affects these large cities, will have some almost unimaginable results. For example, he expects Calcutta to grow from a present population of 7 million to between 36 and 66 million by the year 2000.[4] Bose, on the strength of his study of Metropolitan Calcutta, expects that what happens there "will strongly determine the character and tempo" of urbanization "throughout the entire country" and "the same can be said, in all likelihood, about the roles that are to be played by the metropolises of the other developing countries".[5]

1.1.6 In both developed and developing countries the process of

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1 Mumford, op. cit., p.69. "The French Geographer, Max Sorre, estimates that 4/5 of the world's population lives in villages closer to the neolithic model than to the industrial city."

2 L.H. Long (ed.) The World Almanac. New York: Newspaper Enterprises Assoc., Inc., 1966, pp.323, 672, 673.

3 Davis, op. cit., pp.49-50.

4 Ibid., p.53.

5 N.K. Bose, "Metropolitan Calcutta", Scientific American. Sept., 1965, p.91.

urbanization is beginning to throw up evidences of what is to come. Urban agglomerations are forming in both developing[1] and developed world regions.[2] While some writers argue the possible advantages of this build-up[3] the features of a megalopolis as we know it reflect the disadvantages of an unstructured and uncontrolled environment.[4] Several years ago Doxiadis took the trends mentioned here to what he believes to be their ultimate conclusion in growth, process and form. By the mid-21st century an"Ecumenopolis will grow to a population of from 10 to 30 thousand million."[5] According to Jones this would be approximately 90% of the world population at that time.[6] This figure could possibly increase from 30 thousand million to 60 thousand million by the first quarter of the 22nd century at which time, according to Doxiadis, population would reach a "static" phase.[7] At that time the Ecumenopolis would be a "continuous network of settlements covering the entire earth, with many centres of different magnitude connected by many branches of varying importance, within which

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1 G. Luna, "Megalopolis Trends in Mexico", Ekistics. Vol.24, No.140, July, 1967, p.6; Emrys Jones, "Aspects of Urbanization in Venezuela", Ekistics. Vol.18, No.109, Dec., 1964, pp.420-25.

2 C. Nagashima, "Megalopolis in Japan", M. Bogdanou, "Ecumenopolis Trends in South Europe", Ekistics. Vol.24, No.140, July, 1967.

3 J. Vink, "Bigger Cities or More Cities?", Ekistics. Vol.17, No. 102, May, 1964, p.315.

4 See C. Nagashima's description, op. cit., p.6.

5 C.A. Doxiadis, "Ecumenopolis", Ekistics. Vol. 21, No.123, Feb., 1966, p.111.

6 Jones, op.cit., p.17.

7 C.A. Doxiadis, "The Ecumenopolis Concept" Ekistics. Vol.20, No.116, July, 1965, pp.15-39.

large and small areas of natural landscape with different degrees of man's intervention, will be incorporated"[1] (Map 1.1).

1.1.7 It is just such an urban network, but without the implied order of Doxiadis' model, which worries contemporary urbanologists. Reactions to the overgrown, overcomplex urban form have been strong. Mumford fears that the whole planet could become "an urban hive". Schneider raises the possibility of "chaotic city agglomerations". Geddes called the probable end result "Pathopolis" - the diseased and dying city. Mumford puts it more strongly - "Necropolis" - the city of the dead - or, more simply, the death of civilization. On a less alarming, more pragmatic level Davis suggests that planners should concentrate more on controlling urban population growth and less on building an environment to house it.[2] While this may be the ultimate solution to population growth as a whole it does not solve the problem of how and where to house the population which will come before birth control becomes generally effective. Even if it becomes

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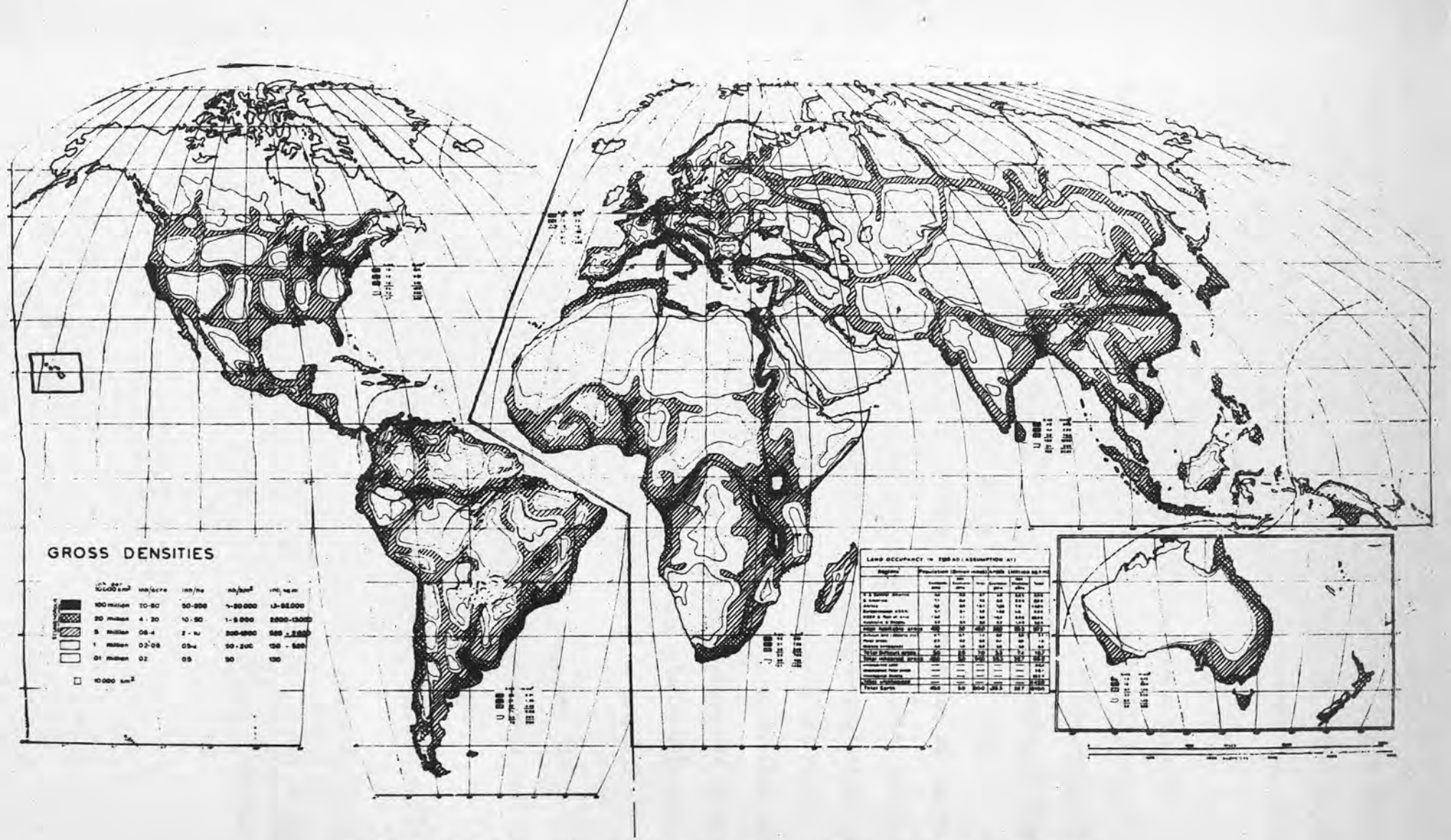
[1] C.A. Doxiadis, "Ecumenopolis", op. cit., p.111. The three necessary ingredients for locating these networks would be large plains, a reasonable climate and water resources. It is interesting that the factors governing Doxiadis' location of the networks are all natural physical features. He seems to ignore the possibility of man's technological progress during the period within which the Ecumenopolis would be forming. By that time man may be able to build satisfactorily, indeed imaginatively, on any topography. He may also be able to produce inviting artificial microclimates and to influence natural weather across the entire face of the earth. Water, of course, is already moved great distances and desalinization of sea water also promises relative freedom from this locational restriction. If man can influence weather, he may also be able to make rain when and where he chooses and in the quantities he needs.

[2] Davis, op. cit., pp.52-53.



MAP 1.1 ECUMENOPOLIS - The 'Static Phase' - 2050 - 2100 A.D.

Source: "The City of the Future", Ekistics. Vol.20, No.116, July, 1965. Map 16.

effective the process of rural-urban migration can continue to result in the growth of urban agglomerations, leaving both world regions and individual countries with unbalanced populations and resources, and a lack of an amenitive urban environment.[1]

1.1.8 Urbanization, which has already produced large, complex environments, will continue to do so even if effective measures of population control are introduced. The projections of urban population to the year 2,000 show an increasing number of people living in large cities. Longer range projections promise an environment which is almost incomprehensible in its complexity.[2] Urbanization is increasing fastest in developing regions which already have large urban concentrations growing without the inducement of rural-urban migration. It seems safe to assume that when these regions experience the full effects of urbanization their problems could be far greater than any yet experienced in the more developed regions. The provision of a suitably structured physical environment for this urban population will be one of the most acute problems in planning for the future.

1.1.9 There have been many physical solutions suggested for these problems. Some form of new community or new town is usually used as

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1 Jean Meyer, "Demographic Aspects of Urbanization", Ekistics. Vol. 18, No.109, Dec., 1964, p.392.

2 However, Blumenfeld in "A Hundred-Year Plan: The Example of Copenhagen", writes, "I agree with Doxiadis that we should attempt to predict whatever may be predictable. We should certainly try to think ahead a hundred years or more, but we should plan ahead no longer than we can predict with reasonable probability." (The Modern Metropolis. Cambridge, Mass.: The M.I.T. Press, 1967, p.106)

a full or partial device in the more thoughtful of these solutions.[1] In 1963 Osborn and Whittick counted approximately 5,000 new communities in over 50 countries.[2] Viet, in his annotated bibliography covering over 200 new towns noted, however, that the list is almost endless.[3] He mentions, for example, that there were 565 new towns in the Soviet Union alone.[4] New communities range in size from the agricultural villages being built in such countries as Israel, Pakistan and Spain to regional cities of 1-3 million people proposed for Japan and Britain.[5]

Urban Britain

1.2.1 Britain "a mere microcosm of the world situation" was the first, and is still the most highly urbanized country in the world.[6] By 1851 over half the population of Britain was urban.[7] By 1891 this figure had risen to 71% and, by 1921, to 78%[8] (Figure 1.5).

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1 United Nations Secretariat, "Recommendations Related to New Towns from Previous United Nations Meetings", Ekistics. Vol.18, No.108, Nov., 1964, pp.295-6.

2 F.J. Osborn and A. Whittick, The New Towns: The Answer to Megalopolis. London: Leonard Hill, 1963, pp.141-148. They estimate that the coming increase in urban population means there may be 2,300 cities with over 1,000,000 people each. In terms of smaller cities this figure would double or treble.

3 Jean Viet, New Towns - A Selected, Annotated Bibliography. UNESCO 1960.

4 Ibid. This figure is now over 800.

5 L. Waters, "Algunas Consideraciones Sobre Las Nuevas Cuidades Inglesas", Hogar y Arquitectura. Madrid: Numero 74. Enero-Febrero, 1968, p.83.

6 Hall, op. cit., p.19; Osborn and Whittick, op. cit., p.152.

7 Weber, op. cit., pp.46, 58.

8 Ibid. These figures include only those people living in places of 20,000 or more in England and Wales and 10,000 or more in Scotland. Also see,Central Statistical Office, Annual Abstract of Statistics. 1965, p.11.

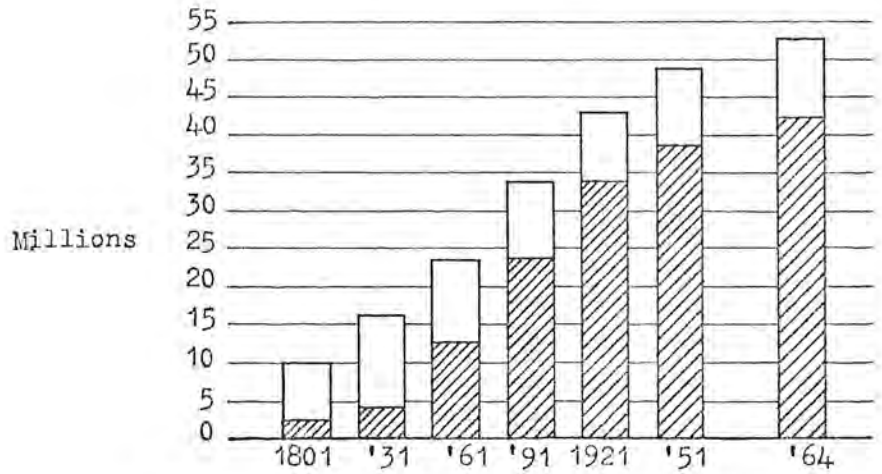

Figure 1.5: Urbanization in Great Britain 1801 - 1964

Total Population
Urban Population

Sources: 1801-1891, A.F. Weber, The Growth of Cities in the 19th Century. pp. 46, 58.
1921-1964 Central Office of Statistics Annual Abstract of Statistics. 1965, p.11

Although urban population has increased slightly since that time, there are more significant figures dealing with the growth of the conurbations.[1] In 1801,when statistics were first gathered, London had as many people as all other city concentrations combined. By 1851 the other cities had 21% of the total population while London had only 15% of the total.[2] By 1901 the respective figures were 26% and 18%. This growth of the northern concentrations was due primarily to their proximity to large deposits of natural resources, particularly coal. With the provision of electric power,and the ease of transport provided by the railway, most types of manufacturing industry were more flexibly located and producers no longer found it necessary to be near the sources of raw materials. By 1951 London had 22% of a

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1 These are seven of the eight conurbations first identified and named by Geddes, op. cit.

2 Weber, op. cit., All figures up to 1895 are taken from Weber.

larger population while the other conurbations had dropped to 21%. By 1964 the respective figures were 22% and 20%[1] (Figure 1.6).

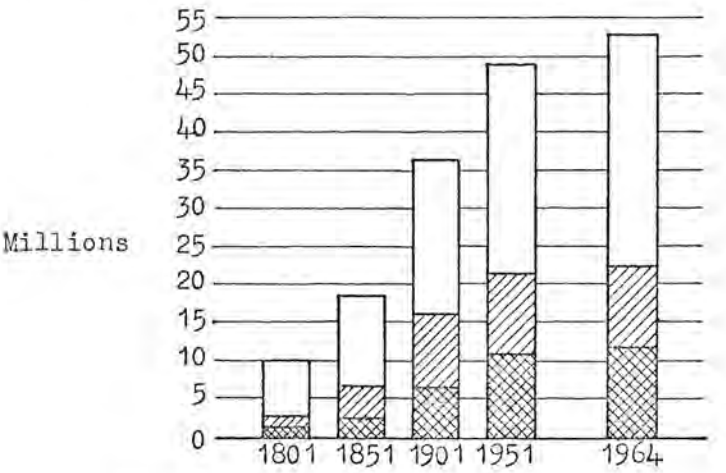

Figure 1.6: Conurbation Populations
Total
All Other Conurbations
London Conurbations

Sources: Central Statistical Office, Annual Abstract of Statistics, 1965, p.11. Peter Hall, World Cities, p.11.

1.2.2 Since 1901 London and the other conurbations combined have always had more than 40% of the total population giving them just over half of the total urban population. These figures indicate that Britain may have reached a 'ceiling' of urban growth relative to the growth of total population. The urban population has remained approximately 80% of the total population for the last 16 years and the populations of the conurbations between 44% and 42% for the last 65 years.[2] However, there have been absolute increases in both urban

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[1] Central Statistical Office, op. cit., p.11; Peter Hall, op. cit., p.11.

[2] There is disagreement on this percentage. See Maurice Barley and Patrick Nuttgens, Living in Towns. London: British Broadcasting Corporation, 1966, pp. 2, 3.

and conurbation populations. There was an absolute increase of nearly 4 million people living in urban places between 1951 and 1964.[1] In the absence of any official projections of urban population approximate projections may be made taking 80% of several estimates for the total population by the year 2000. The figures issued by the Registrars General for England, Wales and Scotland indicate a total population of around 75 million by the year 2000 [2] (Figure 1.7).

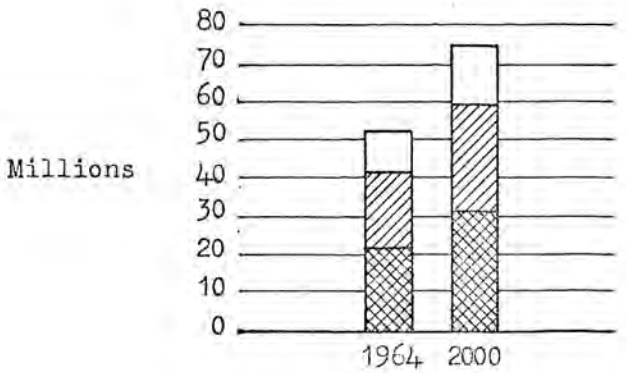

Figure 1.7: Projected Urban and Conurbation Populations

Total
Urban
Conurbation

Source: Central Statistical Office Annual Abstract of Statistics, 1965, p.11.
Peter Hall, The World Cities, p.11, see Footnote 2.

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1 Central Statistical Office, op. cit., pp.10-13.

2 A letter received from the Ministry of Housing and Local Government dated 13 July, 1967 advised the writer that projections of urban population were prepared by the Registrars General of England, Wales and Scotland separately. In response to further inquiries replies dated 11, 25 and 30 August, 1967 respectively from the Registrars General of England, Wales and Scotland made it clear that this information was incorrect. However, a statement in the 1965 National Plan prepared by the Department of Economic Affairs (Part 1, page 97) noted that "A special review has been started in the Department of Economic Affairs to examine population trends, the pattern of settlement and other relevant factors up to the year 2000 and to report on the areas suitable for large-scale development in the longer term". As yet (May, 1969) little has been published on this subject.

Several other estimates substantially agree with this figure.[1] In absolute figures this would mean an increase of 16-17 million people in urban places, with approximately 8-9 million of this increase occurring in the major conurbations.

1.2.3 Britain has been using a major new town building programme for the last 23 years as a corrective for its existing urban overgrowth and as a means for accommodating expected increases in urban population.[2] When Ebenezer Howard first put forward his proposals for a garden city in 1898 Britain's population was already 75% urban. Howard's two garden cities, Letchworth and Welwyn, did not have an immediate impact on the planning of an environment to control urban growth. In the years between World War I and World War II the primary emphasis was on the building of suburbs and trading estates.[3] There were, however, several other examples of attempted new community

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1 J.R. James, "The Next Fifty Years", Journal of the Town Planning Institute. Vol. 50, No.1, Jan., 1964, pp.6, 7; A.E. Holmans, "Implications of Britain's Population Growth", London and Cambridge Economic Bulletin. (Supplement to Times Review of Industry and Technology) No. 52, Dec., 1964, p.xv. Holmans believes that the population increase of England and Wales alone will be 18.5 million.

2 Osborn and Whittick, op. cit., p.137. The present new towns programme will accommodate approximately 1,875,000 people. The Town Expansion Programme will accommodate 1,520,000 but 1,120,000 of these will be in groups of 21,000 or more putting many of them close to the population size of the smaller new towns. One town expansion is for 700,000; another for 210,000. Several of the original new town proposals are now being carried out as large town expansions such as these. (Letter from M.H.L.G., 3 Aug., 1969)

3 Brian Hackett, Man, Society and Environment, The Historical Basis of Planning. London: Percival Marshall, 1950, p.235. One of the primary problems was the slowness with which legislation was proposed and passed to make planning controls comprehensive. Most of those enacted, according to Hackett, "only encouraged piecemeal planning and disorderly development at the local level".

development.[1] None of these developments, however, related to its respective city as a definite element within a total comprehensive plan.

1.2.4 Ashworth has succinctly summed up the primary characteristics of the physical environment built during this period:

> 1) There was little recognizable difference between developments under planning legislation and that outside it.
>
> 2) The best of this development was in the form of garden suburbs and low density residential or trading estates with little provision of social amenity.
>
> 3) However admirable the internal arrangement of certain individual projects, externally they seldom did much to lessen the confusion in the arrangement of cities.
>
> 4) There was, however, a continued interest in treating these problems on a regional and even national basis.[2]

1.2.5 This concern with urban form and larger scale planning invariably suggested new towns as the primary built forms for carrying out these proposals. Howard, in fact, had suggested a regional

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[1] Ashworth, The Genesis of Modern British Town Planning. London: Routledge and Kegan Paul, Ltd., 1954, pp.209-210; Walter Creese, op. cit., pp.255-72. In 1919 the London County Council bought 3,000 acres in Essex County to build a garden city and satellite town for 120,000 people. Called the Beacontree Estate, it was developed piecemeal, with little provision for separation from neighbouring elements, attraction of industry, social, educational and shopping facilities, until nearly 15 years later. Wythenshawe, adjoining Manchester, and Speke, outside Liverpool, were two well-known attempts to combine garden city, garden suburb and estate ideas. London suburbs such as Golder's Green and Ruislip Manor were supplemented by trading estates such as Roehampton, Morden and Bellingham.

[2] Ashworth, op. cit., pp.197-212.

grouping for his garden cities.[1] A spate of individual proposals during the first 15 years after World War I suggested regional and national groupings.[2] As early as 1920 a committee of the Ministry of Health had suggested the building of garden cities outwith London for the decentralisation of population and industry.[3] This idea was used by Raymond Unwin in his 1933 report on establishing a "green girdle" around London with "satellite villages".[4] Unwin's proposals were partially implemented when,in 1935, the London County Council put forward a proposal to preserve nearly 18,000 acres for a greenbelt. Although the land was preserved by a 1938 act[5], Unwin's plan for satellite communities was not implemented.

1.2.6 Further interest in regional and national planning, prompted in part by the need to decentralize London's population during World War II,

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1 Ebenezer Howard, Tomorrow - A Peaceful Path to Real Reform. 1898. Republished as Garden Cities of Tomorrow. London: Faber and Faber, 1945, p.143.

2 See, for example, C.B. Purdom, "The Garden City After the War", published by the author, 1917; F.J. Osborn, "New Towns After the War", London: Dent, 1918; A. Trystan Edwards, "A Hundred New Towns for Britain", published by ex-serviceman J47485, 1934.

3 Ministry of Health, "Interim Report of the Committee to Consider and Advise on the Principle to be Followed in Dealing with Unhealthy Areas". 1920.

4 M.H.L.G., The Green Belts. London: H.M.S.O., 1962, Reprinted 1964, pp.2-3. Most of these satellite communities were formed around existing built-up areas which makes them appear more as town expansions than new towns.

5 "The London and Home Counties Act - 1938".

led to the Greater London Plan - 1944.[1] Here for the first time a regional plan made detailed proposals for the structure of a region. Among them was the provision for removal of 618,000 people from the County and 415,000 from an inner Urban Ring which meant that over 1 million people were to be relocated. Of this number, 37% were to be housed in quasi-satellites or in additions to existing towns inside the plan area but outside the built-up area, and 26% were to be located in existing towns outside the plan area or entirely away from metropolitan areas. The remaining 37% were to be located in eight new satellite towns to be built outside the Green Belt Ring.[2]

1.2.7 The comprehensive nature of the plan can hardly be questioned. Many of its proposals for new town development were implemented in the 1946 New Towns Act. This act, based on the Reith Committee Reports, established the designation of sites as a matter of national policy and the setting up of public development corporations by the then Minister of Town and Country Planning.[3] These towns had one of two

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1 See, "Royal Commission on the Distribution of the Industrial Population" London: H.M.S.O., 1940. In 1941 the Town and Country Planning Association published 9 points for a national plan which included the relocation of industry and business in new and country towns. The County of London Plan-1943 (London: Macmillan and Co. Ltd.)mentioned four major internal defects of the County of London and made reference to the 'continual sprawl' of the City but left specific proposals to the 1944 regional plan. (p.3)

2 Patrick Abercrombie, Greater London Plan - 1944. London: H.M.S.O., 1945, p.33. Abercrombie, however, preferred an alternative proposal for redeveloping the central area at 100 people per acre (241 people per hectare) instead of 130 people per acre (313 people per hectare) which would have necessitated removing an additional 100,000 people outside the plan area and an additional 95,000 to two more new towns. (p.200, Appendix 12)

3 "Reports of the New Towns Committee", London: Cmd: 6759, 6794, 6876, First Interim Report, April 1946; Second Interim Report, June, 1946; Final Report, July, 1946.

functions. They were either to take excess population from the large conurbations or to centralize scattered population in declining industrial areas. Eight of the first fourteen new towns (although not all of Abercrombie's eight) were located around London. Four others were located in industrially declining areas in England.[1] The remaining two were designated in Scotland under the 1946 New Towns Act (Scotland). One of these was to take Glasgow overspill; the other was located in an industrially declining area.

1.2.8 During the 10 years after the last of the post-war new towns were started only one other new town was designated. Cumbernauld, in Scotland, was also to take Glasgow overspill. From 1961 to 1964, however, five new towns were designated. Two were included in subsequent sub-regional studies.[2] These studies were significant for aside from the 1946 Clyde Valley Plan[3] no regional studies had been done since the London plan which treated the problems of urbanization in developed urban regions. In 1964 the first major regional

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1 In 1945, "The Distribution of Industries Act" established industrial development areas in certain parts of the country. These areas have no been extended to cover large portions of the underdeveloped regions, Anthony Gross, British Industries and Town Planning. London: Fountain Press, 1962, p.8.

2 Livingston, designated in 1962, was named in the November, 1963 Central Scotland Programme (Edinburgh: H.M.S.O. Cmnd.2188, November 1963) as one of five growth areas. Washington, then being considered for designation, was included in the 1963 North East Study (London: H.M.S.O. Cmnd. 2206, November, 1963) within the context of the Tyneside/Wearside Growth Area.

3 Sir Patrick Abercrombie and Robert H. Matthew, The Clyde Valley Regional Plan - 1946. Edinburgh: H.M.S.O., 1949. An overspill population of 500,000 was proposed, 250,000 of which would be located in new towns at Cumbernauld, East Kilbride, Bishopton and Houston.

plan was published for the South East Region.[1] This was followed by additional economic plans for various regions of Britain so that by the middle of 1969 only Wales and Monmouthshire had not received some form of regional attention.[2] Most of these plans advocated new town development as part of their proposals. As a result there are now 27 new towns in Britain. Twenty of these are in England, two in Wales and Monmouthshire and five in Scotland.[3] There are, in addition, proposals for larger new cities within the context of the regional plans. Some of these are pending designation under the New Towns Acts, while others have been classified as larger town expansion schemes[4] (Map 1.2).

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1 M.H.L.G. The South East Study. London: H.M.S.O., 1964. This has been superseded by Strategy for the South East, London: H.M.S.O. 1967 which leaves out East Anglia and part of the South West Region included in the earlier plan.

2 There has been a great deal of discussion about what constitutes a region. Regions are, by most definitions, areas of some type of homogeneity. Historically, the boundaries of regions have been defined by geographic limitations or the extent of city influence. Recently there have been many attempts to define city-oriented regions. The planning regions of Britain have little relation to these attempts, however, for they are primarily based on the division of the county into 10 civil defence regions during World War II. The planning regions of England and Wales are devised from these civil defence regions (see L. Dudley Stamp, Applied Geography. Pelican, 1960, p.171). The planning regions of Scotland have been designated by the Scottish Development Department. See Map 1.2 for the demarcation of regions to 31 Dec., 1969.

3 M.H.L.G., Scottish Development Department, Welsh Office and Central Office of Information, The New Towns. London: H.M.S.O., 1969.

4 The Town Development Act, 1952, England and Wales, set up a framework for co-operation between larger urban areas wishing to rehouse excess population and smaller local authorities willing to accept this population. As of October, 1968 there were 65 such town expansion schemes in England. There have also been several local authority schemes which have considerable dependence on private investment and development.

MAP 1.2 THE BRITISH NEW TOWNS

1.2.9 One of the primary concerns of the new town idea in Britain since its inception has been the limitation of the size of communities. Howard's garden city principles were directed towards the limitation of size of the towns to 32,000 each and the regional units to 250,000 each.[1] The Reith Reports suggested new towns of 20,000 - 80,000 population with perhaps another 20,000 within a ten mile radius if the town was "isolated".[2] The mean average ultimate population of the first fifteen new towns designated was 72,400 but this was because some towns have their original ultimate populations considerably increased. Five of the towns were of 55,000 people or under (Table A.1.7).

1.2.10 The belief that large towns are inherently chaotic has always influenced the thinking on town size in Britain, usually with London in mind. Howard's proposals were a direct reaction to London's condition as were most of the proposals up to and including the early new towns. The urban agglomerations which cause such alarm among contemporary urbanologists were not originally discovered by Gottman in the contemporary United States but by Geddes in the Britain of a half-century ago. Britain today, even if it has reached a 'ceiling'

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1 Mumford's succinct enumeration of the four fundamental principles of Howard's idea shows this: 1) Limitation of population and area; 2) Growth by colonization; 3) Variety and sufficiency of economic and social opportunities; 4) Control of land in the public interest. (Osborn and Whittick, op. cit., p.3) The second of these principles is a direct result of the first. In order to limit town size Howard proposed building more towns of the same size. To provide the variety and sufficiency of opportunity he reasoned that these should be organised into city regions each with 6 towns of 32,000 people each as satellites around a central city of 58,000 or a total of 250,000 people. To ensure the control of the size and opportunities, however, he advocated the fourth principle as well.(Howard, op. cit., p.143)

2 " Report of the New Towns Committee," op. cit., Final Report, pp.8-9.

of urban growth, will still have an increase of 16-17 million people in all urban areas, and 8-9 million in the conurbations alone if the present trends continue.

1.2.11 An editorial in the March, 1967 issue of Official Architecture and Planning substantially agrees with this estimate. Putting the population increase in terms of new towns the O.A.P. believes the increase would be the equivalent of a new town of 100,000 every ten weeks or 176 new towns by the year 2000. Mellish, speaking at a new towns teach-in in 1967, stated that at present 1.5% of the total population live in new towns and forecast that by 1981 5% of the total population would be new town inhabitants.[1] If the total population increase is put into new towns, as has been suggested by some planners, then by 2000 approximately 28% of Britain's population would be new town inhabitants .

1.2.12 Estimates of this kind do not take into account two additional large-scale considerations, however. First is the need to rehouse a large amount of the present urban population, particularly that in the conurbations, in better premises.[2] The second is the need to re-invigorate declining regions which need, among other things, new,

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1 Robert Mellish, then Parliamentary Secretary to the Ministry of Housing and Local Government, stated that as of 31 March, 1967 1 person in 65 was a new town resident and that 1 person in 20 would be. (Letter from the M.H.L.G., 1 August, 1967.)

2 National Department of Economic Affairs, The National Plan. London: H.M.S.O. Cmnd. 2764, pp.76-88. The plan forecasts a shortage of some 4-5 million dwellings by 1981 and proposes building 500,000 dwellings a year to alleviate this shortage.

centralized urban development.[1] These needs have led to proposals for the building of much larger new communities. These range from 1/2 - 3 million people[2], the upper limits closely approximating the populations of some smaller conurbations. In fact most of the designated new communities are at a city scale rather than a town scale[3] (Map 1.2). Several proposals are for a variety of sizes and forms of new communities as components of the development of an urbanized Western Europe.[4]

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1 J.B. Cullingworth, Town and Country Planning in England and Wales. London: George Allan and Unwin, Ltd., 1964, pp.258-62. Cullingworth statistically identifies "two nations", one made up of declining regions, and argues against the depopulation of these regions. He notes that the figures he uses are based on two articles in the Housing Review. Vol. 9, No.5, Sept.-Oct., 1960 by himself and McCulloch. His figures were not, however, part of the original article as published in that issue, but were published by the M.H.L.G. in 1955 (Cmnd. 9593) (Letter from Cullingworth dated 22 April, 1968).

2 See, for example, Arthur Ling, "The Newest Towns", New Society. 9 July, 1964, pp.163-168; Leslie Lane, "Humber - Counter-magnet to London: Showcase for Britain", The Architects' Journal. Vol. 143, No.3, 19 January, 1966, pp.1171-1183; Harry Teggin, "A City on the Wash", Listener, 26 May, 1966; D. Rigby Childs, "Trend, Countertrend or Counterdrift", The Architects' Journal. 15 Jan., 1964, pp.121-4 ; R.F. Nicoll, "The Physical Implications of the White Paper on the Scottish Economy 1965/70", Journal of the Town Planning Institute. Vol.52, No.8, Sept./Oct.,1966, pp.314-18. Lane's proposals involve a city of 1 million on the Humber. Teggin's city on the Wash would be for 750,000. Proposals, since rejected, were made for a new city of 1 3/4 million in Hampshire by Colin Buchanan and Partners and Economic Consultants Limited in the South Hampshire Study. (London: H.M.S.O., published for the M.H.L.G. 1966, 1 Volume with supplementary Vols. 1 & 2.) Proposals have also been made for a city on the Solway Firth for 2-3 million people (Map 1.2).

3 Mellish, speaking at the June, 1967 "New Town Teach In" at Harlow noted that future new towns would actually be larger new cities. The designation of the two newest towns of Milton Keynes and Peterborough with populations of 250,000 and 175,000 seem to indicate this trend. Other existing new towns are being considered for expansion to larger new cities.

4 H. Rau, "A Plan for Britain", Journal of the Town Planning Institute. Vol. 51, No. 5, May, 1965, pp.195-8; W.S. Butler, "Towards a Strategy for Europe", Northern Architect, May, 1966, pp.622-3.

Summary

1.3 The technological revolution, as other revolutions before it, is producing a distinctive type of urban form which, if present projections are correct, will be the dominant living environment in 30 years' time. Further, this urban revolution has barely affected the world regions which contain a vast part of the world's populations. The structure of this urban form is of prime concern to contemporary urbanologists who are concerned with its possible chaotic results. Britain as the first, most highly urbanized country in the world has initiated an extensive national programme to control urban growth which relies heavily on the provision of new towns. The size and structures of existing large cities have always been a primary factor motivating the building of new towns in Britain with the result that the first new community proposals were of limited size and form.[1] Now, however, new communities are being designated within the context of regional and national factors which in size and form are more to the city scale. Proposals have been made for new developments having a range of sizes and forms which would be components of a European region approaching the scale of proposals for world urbanization (1.1.6). The structure and form of these new communities will be one of the major planning problems in the next 30 years and they should offer some ideas for an orderly restructuring of existing communities.

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[1] An ambitious work by R.L. Martin, The Correlates of Settlement Size (published by the Edinburgh College of Art, Nov., 1966) gives a discussion of internal factors affecting settlement size.

CHAPTER II

2.0 In planning there has often been a preoccupation with the form of the built environment. This has sometimes been criticised as attention to the most superficial aspect of planning; a concern with the end-product rather than with the social and economic forces which generate this product. This Chapter questions this assumption in three parts. First it will examine some of the reasons for interest in form - especially in that of the urban environment. Second, the development of form elements is briefly traced. Particular attention is paid to the development of ideal new towns as attempts to express improved urban forms. Finally, the purpose of urban form is discussed by relating these form elements to current human needs.

Form

2.1.1 Form has been defined as shape - the external appearance of a thing - and as the arrangement by which these shapes are ordered.[1] Form thus has two aspects: 1) the external appearance of a single subject, 2) the external appearance of the arrangement of a complex of subjects. Arnheim notes that these two aspects, variously termed 'form' or 'shape', have the purpose of conveying information about the subject.[2]

2.1.2 Man's primary interest in form stems from the fact that he comprehends this information primarily through his eyes. Much has been

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[1] Fowler and Fowler (eds.), The Concise Oxford Dictionary. Oxford: The Clarendon Press, 1964.

[2] Rudolf Arnheim, Art and Visual Perception. Los Angeles: University of California Press, 1965, pp. 32-39.

written about the eye, but as yet little is known about its complicated and intricate structure.[1] It is not the purpose of this study to examine the working of the eye in detail but several facts emphasize its importance to man's relationship with the environment. First, it has played a major role in the evolution of the human species. Once thought to be merely a neutral device "for revealing a real world to the inquiring mind" it is now recognized to be much more - a sort of brain in itself.[2] Its influence on human development is so pervasive that it is credited with causing the evolution of two physical appendages that man finds extremely interesting - the brain's neocortex and the female breast.[3] Second, it is the major information-gathering device. Although sometimes misleading, and often used in conjunction with other senses, man depends primarily on vision to receive and process information about his surroundings.[4] Finally, it is the sensor closely allied with that part of the brain by which man initiates most of his activities. The eye is directly connected with the forebrain which is responsible for his creative thinking.[5]

2.1.3 It is for these reasons that the appearance of subjects is

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1 See, for example, R.L. Gregory, Eye and Brain. London: World University Library, 1966; John Davy, "There's More to Seeing than Looking", Sunday Observer Magazine. 7 Dec., 1969, pp. 14-22.

2 Davy, Ibid., p. 16.

3 Gregory quoted in Peter Laurie, "Geography of Psychosis", The Sunday Times Magazine. 19 March, 1967; Desmond Morris, The Naked Ape. London: Corgi Edition, 1968, p.67.

4 Otto Lowenstein, The Senses. Baltimore, Md.: Penguin, 1966, p. 16; Elbert Tokay, The Human Body and How It Works. New York: Signet, 1957, p. 140; Gregory, op. cit., p.13.

5 R.W. Gerard, "The Biological Basis of Imagination", The Scientific Monthly. June, 1946, pp. 67-72; Gregory, op. cit., pp. 68-72; Arthur Koestler,"What's Wrong with Us?" The Observer Review. 28 April, 1968, p. 32. 'Idea' comes from the Greek 'id' meaning "to form" and "to see".

important. Form seems to be the aspect of appearance which is most necessary for understanding.[1] Arnheim describes a man suffering from a brain injury who almost completely lost the capacity for visual perception. He was still able to get along in daily life, however, since he could distinguish among broadly differing shapes.[2] Conversely, Gregory describes a man who had his vision restored but became so depressed over his inability to link newly perceived forms to his other more highly developed sensory perceptions that he eventually died.[3] The more disturbing common eye disorders, such as astigmatism or myopia, are those which affect the perception of shape while colour blindness, for example, is not considered a serious handicap in visual perception. Even the form of tiny objects is important, such as the pupil of the eye in expressing emotion. Perhaps the easiest way to understand the importance of form, however, is to realize that most visual qualities - scale, proportion, mass and void, rhythm, light and dark, colour, texture and composition - only contribute to the overall perception of both single forms and form complexes.

2.1.4 Individual forms and the arrangement of form complexes provide man with the majority of his information about the three-dimensional environment.[4] Interest in form has always been related to the appearance of the environment. Hall states that man's ancestors changed from depending on primarily olfactory sensations to primarily

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1 Franz Boaz, Primitive Art. New York: Dover Publications, Inc., 1955. Boaz notes that "the emotions may be stimulated not by the form alone but also by close associations that exist between the form and ideas held by the people". (p.12)

2 Arnheim, op. cit., p.32.

3 Gregory, op. cit., p.51.

4 Lowenstein, op. cit., p.49.

visual ones when "forced by interspecies competition and changes in the environment to desert the ground and take to the trees".[1] Although he has since returned to the ground man, like other species, has been continuously affected by the nature of his surroundings.

2.1.5 Alexander notes that "every design problem begins with an effort to achieve fitness between two entities: the form in question and its context".[2] In this case the form in question is man and the context is the environment. At first man was only a receptor of influences reacting to a completely natural environment.[3] Slowly he began to evolve a culture and by some three thousand years ago had developed the notion of a psyche - of himself as a thinking individual unique in the environment.[4] Whitehead calls this development the "first stage of great ideas" and believes that man used it "as a master-key to make intelligible the baffling occurrences of nature".[5] Man used this newly conceived status to influence what he could in the environmental structure, but many 'baffling occurrences' were more easily explained by attributing them to supreme beings. Organized religion furthered man's interest in a supernatural or metaphysical environment which would operate in an ideal

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1 Edward T. Hall, The Hidden Dimension. Garden City, N.Y.: Doubleday and Co., 1966, p.36.

2 Christopher Alexander, Notes on the Synthesis of Form. Cambridge, Mass.: Harvard University Press, 1964, p.15; also "From a Set of Forces to a Form", Interior Design. October, 1967, pp.36-39, 61.

3 Charles Darwin, The Origin of Species. New York: Mentor, 1958 (First published, 1859).

4 Koestler states that the neocortex which facilitates man's creative thinking was imposed over the old brain with "unseemly haste only during the second half of the Pleistoene Period". Op. cit., p.25.

5 Alfred North Whitehead, Adventures of Ideas. Cambridge: The University Press. First published, 1933, paperback edition, 1961, p.18.

state of order. Some activities were directed toward achieving this state in the existing environment and what Whitehead calls "interim ethics" were devised to cope with conflicts between man's relationships to both the natural and supernatural environments.

2.1.6 The interest in an ideal environment persisted although the metaphysical environment proved difficult to accomplish based on the tenets of organised religion. The intellectual revolution in the late medieval period and the scientific revolution in the seventeenth century have been given by various authorities as the causes of man's reawakened interest in the nature of his surroundings.[1] Although this interest had not been quite as dormant as suggested there is no doubt that man's understanding of his environment since that time has increased considerably. Toulmin and Goodfield observe that "it is perhaps the most remarkable of all natural events that a species has grown up in an environment and has ended by understanding it".[2]

2.1.7 This view is slightly misleading. Man has not 'ended' except in terms of his previous development; he is still evolving. Lorenz believes that today's man is "only a link between animals and the really humane being".[3] Moreover, his knowledge of the environment is still extremely limited, both in terms of what he understands and in the amount of this understanding he can apply for any practical purposes. Yet

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1 Ibid.; Lowenstein, op. cit., p.200.

2 S. Toulmin and J. Goodfield, The Architecture of Matter. Pelican, 1965, p.433.

3 Konrad Lorenz, On Agression. (trans. by Marjorie Latzke), Vienna: 1963, University Paperback Edition, London: Methuen and Co. Ltd., 1967, pp.9, 197.

he is a long way from being just 'a receptor of environmental influences'.[1] He has not only developed some understanding of his environment, he has constantly sought to manipulate it for his own purposes. Unfortunately, this manipulation has been only partially successful and has resulted in the form of urban growth and its concomitant problems which were surveyed in Chapter I.

2.1.8 This does not mean, however, that man has not been aware of the problems he has created by environmental manipulation or that he has not been able to propose solutions for these problems. This may be seen by briefly examining the development of urban form, particularly with regard to that of ideal new towns proposed as models containing solutions to some problems of the man-made environment.

Urban Form - Real and Ideal

2.2.1 It is somewhat misleading to think of ideal new towns as developed only to accommodate utopian societies within the framework of the perfect urban environment. In addition to building new towns[2] many of the great cities of history had plans for ideal towns. An examination of the urban populations of these cities when the better known ideal new town plans were proposed shows that most of these were partially in reaction to chaotic urban growth. The Athens in which Plato wrote the Republic and Laws had over 100,000 people, many crowded into the four fifths of a square mile of inner city which Mumford describes

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[1] Ibid., pp.4, 255.

[2] Lewis Mumford, The City in History. Pelican, 1966, pp. 240-243. The Greek city of Miletus established over 70 new colonies. Rome established over 430 new towns in Italy alone.

"from the standpoint of town planning and hygiene" as "a deplorably backward community".[1] Vitruvius' plans for an ideal new town were formulated in a Rome of 1.2 million people who lived in an area of little more than five square miles. The inner city had a population density of about 450,000 persons per square mile, a figure comparable to today's Bombay, Hong Kong or Calcutta. Human misery and suffering were common. The streets were so crowded that vehicles were ordered to use them only at night.[2]

2.2.2 Many medieval cities, especially those which were outgrowths of the planned Roman colonies, supported much better urban conditions. The interest in the well-functioning urban environment described by Mumford in the medieval town seems related to the contemporary interest in "Christianopolis" - the metaphysical environment.[3] Urban growth caught up with the medieval town, however, just as the many practical problems of daily life caught up with the "interim ethics" described by Whitehead. It was "at this point in urban building" when "the now meaningless enclosure, and the disorder and clutter that often characterized the late medieval city, had become intolerable."[4] Plans such as Filarete's Sforzinda were formulated in a Florence rapidly approaching a population of over 100,000 and conditions of urban overgrowth.[5] More's

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1 Ibid., p.154; Wolf Schneider, Babylon is Everywhere. London: Hodder and Stoughton, 1963, p.128.

2 Schneider, op. cit., pp.137-8.

3 Mumford, op. cit., p.346; Cecil Stewart, A Prospect of Cities. London: Longman's Green and Co., Ltd., 1966, pp.41-43.

4 Mumford, op. cit., p.399.

5 Stewart, op. cit., p.97; Christopher Tunnard, The City of Man. London: The Architectural Press, 1953, p.240. These descriptions are of Florence from about 1480. Filarete's plans date from 1460-1464.

Utopia was partially written in Flanders where Antwerp and Bruges had populations of over 100,000.[1] His home town of London had even more "severe problems of overcrowding".[2] Models of new communities proposed in Britain by those whom Marx termed the "utopian socialists" were more to the village scale than their predecessors. Britain was traditionally a country of villages[3] and the first communities of the industrial revolution were village clusters. The results of the Industrial Revolution and the growth of larger metropolises soon made these new town models more pertinent to the solving of urban problems such as those experienced in London (1.2.1 - 1.2.5).

2.2.3 Howard's Garden Cities and the models which followed, including the current British new towns, have their roots in the tradition of these ideal communities as proposed solutions to the problems of urbanization.[4] Stewarts' description of the new towns of history indicates that generally they had the same functions as their modern counterparts: 1) to take excess population from the mother city, 2) to exploit undeveloped regions.[5] The ideal town, whether built or proposed,acted as a model for new towns and each

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1 Mumford, op. cit., p.407; Thomas More, Utopia (translated by J.H. Lupton). Oxford: Clarendon Press, 1895, pp. xxix-xxx. Book I was written in Antwerp, Book II in London.

2 Mumford, op. cit., pp.498-499.

3 Steen Eiler Rasmussen, Towns and Buildings. Liverpool: The University Press, 1951, p.103.

4 Stanley Buder, "Ebenezer Howard: The Genesis of a Town Planning Movement", Journal of the American Institute of Planners. November, 1969, pp.390-398. Buder notes that "Utopian thinking thrives in periods when people are acutely conscious of the discrepancy between man's potential and the possibilities of his technology as compared to the relative backwardness of his social system." (p.399)

5 Stewart, op. cit., pp.4-6.

had similar functions and form elements. Both were parts of attempts to solve the problems created by man's manipulation of the environment and, as such, had a basic relation to existing functions and form elements. Although urban form is the result of many different and changing activities and functions some of these basic form elements are common throughout its historical development. Mumford has postulated that the basic physical elements of city form were recognizable by 2500 B.C.[1] If these elements are summarized under the classifications of areal forms and linear forms their developments may be briefly traced in both the real and ideal urban environments.

2.2.4 Areal forms are those which have developed primarily out of activities that are grouped in one area or location. They are characterized by a cluster of forms. Originally the neolithic village was a complete self-sustaining unit, although transitory in nature.[2] Village units at first were satellites to the walled "imperial" city but were gradually included within the walls as these cities expanded into the pre-industrial city form.[3] Villages were characteristically homogeneous units based variously on the worship of particular gods or on the common occupations or social classes of the inhabitants. They were the first residential 'units' and were built up around various foci such as temples, markets, and workshops.[4] In the industrial

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1 Mumford, op. cit., p.109.

2 Emrys Jones, Towns and Cities. London: Oxford University Press, 1966, p.69; Schneider, op. cit., p.26; V. Gordon Childe, What Happened in History. Penguin, 1964, pp.57-60.

3 Mumford, op. cit., p.549.

4 Ibid., p.24, pp.149-158, pp.354-356; Schneider, op. cit., p.364.

villages, and the industrial cities which followed, manufacturing functions often occupied these centres possibly growing out of the workshop districts.[1] More recently educational functions have replaced work functions as foci for the 'neighbourhood unit'.[2] Other areas with particular functions such as industry varied among locations, such as the periphery of the pre-industrial city or the central area in the industrial city.[3] Marketing, storage, entertainment and sports areas have all been located in various parts of the city: at the periphery, along major streets and in the central areas.[4] The central area, which Jones has termed the city's "monumental climax", has always housed the the major religious functions and the administrative and governmental functions which grew out of them in addition to the other functions located there at various times.[5] Up to the time of the dramatic increase in transport in the second half of the Industrial Revolution the city primarily grew by areal units as epitomized in the growth of the medieval city.[6] Several modern theories of urban growth are based on

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1 Mumford, op. cit., pp.508-532.

2 Patrick Abercrombie, Greater London Plan - 1944. London: H.M.S.O., 1945, pp.33, 111-112. These proposals were based on Ministry of Education proposals for a size of population needed to support a primary school. They were adaptations of physical proposals formulated by Clarence Perry for the 1929 New York Regional Plan (3.3.2.1).

3 Mumford, op. cit., pp.87, 248, 508-522; Arthur Smailles, The Geography of Towns. London: Hutchinson and Co., Ltd., 1966, p.14; Brian Hackett, Man, Society and Environment. London: Percival Marshall, 1950, p.18, pp.176-177.

4 Mumford, op. cit., pp.87-90, pp.508-520; Schneider, op. cit., p.104; Jones, op. cit., pp.6, 25.

5 Mumford, op. cit., pp.91, 395-404; Gordon Childe, op. cit., p.40; Schneider, op. cit., p.359; Jones, op. cit., pp.55-56, 74-75.

6 Kurt Rowland, The Shape of Towns. London: Ginn and Co., Ltd., 1966, p.12.

areas as the major elements of urban form.[1]

2.2.5 Linear forms have developed primarily out of the coordination of linear activities.[2] There was little need for streets or paths in the neolithic village due to its small size and arrangement.[3] In the early pre-industrial city streets were usually provided only for major service functions and ceremonial occasions. In most parts of the city buildings, not streets, were the defining elements. The earliest planned towns, such as Miletus, had streets which defined the major neighbourhoods, and networks of irregular paths within the residential units, but up to the early Renaissance street and path networks were often haphazard.[4] The growth of the medieval city occurred in self-contained units instead of along streets. This resulted in the varietal street pattern which was, and still is, highly regarded. Larger streets often radiated from the central area to the gates in the city walls. There were also 'ring roads' which were formed when the city walls were demolished and rebuilt further out.[5] The High Renaissance and Baroque streets, designed for continuous facades, wheeled vehicles, enfilade cannon fire and parades, became much more geometric elements but the streets of the industrial towns and cities were often

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1 Jones, op. cit., pp.140-141.

2 This discussion is limited to human activities but the definition holds for all linear movement such as the movement of water and waste in what Mumford terms "the underground city".

3 See, however, Gordon Childe (op. cit., pp.60-66) for descriptions of neolithic villages in the Alpine Moors with corduroy streets and one in the Orkney Islands which had covered alleys.

4 Jones, op. cit., pp.20-21, 72-73; Hans Blumenfeld, "Form and Function in Urban Communities", The Modern Metropolis. Cambridge, Mass.: The M.I.T. Press, 1967, p.24.

5 Mumford, op. cit., pp. 348-350; Hackett, op. cit., p.41.

no better or well organized than those of most pre-industrial cities.[1] The Victorian by-law streets were a vast improvement, however, and were often the sole organizing feature of the industrial city.[2] Modern transport and communication networks, primarily responsible for the growth of the technological city, have taken over much more of this function of organisation with a resultant scatter of areas along their paths.[3]

2.2.6 It has been proposed that ideal communities were planned to alleviate the problems of urban growth as much as to accomplish a utopian society. The forms of these communities are often thought of as unrealistic. Rosenau believes that Plato's and Vitruvius' plans for new towns had their origins in attempts to satisfy some of the formal laws of geometry.[4] Mumford faults More's Utopia for failing to transform his social ideas into physical form.[5] The Baroque ideal plans, the plans of the Utopian socialists, and Howard's plan all used the radial concentric pattern which Mumford criticises as merely signifying "the military conquest of space" and not taking the "human results into account."[6] This is the plan that Zucker has called the "idée fixe" of all ideal new town form.[7] Its influence is also evident in the early

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1 Blumenfeld, op. cit., pp.10-12; Mumford, op. cit., pp.429-460.

2 Jones, op. cit., p.56.

3 Blumenfeld, "The Modern Metropolis", Scientific American. September, 1965, p.64; Mumford, op. cit., pp.540-596. Melvin Webber, "Order in Diversity: Community without Propinquity", Cities and Space (ed. L.Wingo, Jr.).Baltimore: Johns Hopkins Press, 1963.

4 Helen Rosenau, The Ideal City. London: Routledge and Kegan Paul, Ltd., 1959, pp.13-16.

5 Mumford, op. cit., p.375. 6 Ibid., p.447.

7 Paul Zucker, Town and Square. New York: Columbia University Press, 1959, p.102.

plans for Letchworth, Hampstead Garden Suburb and Welwyn. The Letchworth plan, which has been called "loose and informal"[1] and "a radical departure from the rigid or geometrical forms of most earlier plans"[2] in fact had approximately one quarter of its entire area taken up by a radial concentric 'central area', which is anything but loose and informal[3] (Figure 2.6, p.46).

2.2.7 There are two indications, however, that the geometric plan was also meant to act as an orderly physical framework upon which the planner could organize form elements which were closely coincidental with those of his contemporary urban environment. The first indication is the often detailed attention given to the size of the plan. Plato's town was to accommodate 5,040 households.[4] Vitruvius' scale of towers 'a bow's shot apart' gives a town of approximately 205 acres (96 hectares) which compares with the sizes of many Roman colonies of the times.[5] Filarete's Sforzinda was carefully scaled by stadia, each roughly equal to 0.7 metre which would yield a town of 1,600 acres

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1 Walter Creese, The Search for Environment. New Haven, Conn.: Yale University Press, 1966, p.206.

2 F.J. Osborn and Arnold Whittick, The New Towns - The Answer to Megalopolis. London: Leonard Hill, 1963, p.38.

3 The original Letchworth plan is published in C.B. Purdom, The Letchworth Achievement. London: J.M. Dent and Sons, Ltd., 1953, pp.16-18. The above descriptions probably refer to later versions of the plan or to the town as actually built which changed much of the original plan and resulted in a less formal layout.

4 Plato, Laws. Book V, translation by R.G. Bury, London: William Heinemann Ltd., Vol. I, p.359.

5 Stewart, op. cit., p.102. The record bow shot is 972 yards (885 metres). Giving Roman archers the benefit of the doubt the distance between towers was approximately 1/3 mile (.536 kilometre).

(752 hectares) according to his plans.[1] More's Utopia was planned for a population of 100,000 - 240,000.[2] Most of the later plans had fixed sizes of areas and populations. A second indication is in the ideas governing expansion. Nearly all proposals were based on limiting the size of the population and letting expansion take place in satellite communities or whole new towns. While this has been criticised by some writers[3], it was the predominate pattern of urban growth up to the late Industrial Revolution (1.1.0). Many authors of ideal plans also included treatises on the surrounding regions and what their nature should be to support this growth.

2.2.8 The primary indication of coincidence between real and ideal towns, however, is in the similarity of their form elements. All ideal towns contained areal forms organized on the basis of town residential units or special activity areas. Plato's twelve neighbourhoods varied by social class with some focussing on certain temples.[4] Vitruvius' sixteen neighbourhoods or "insulae" were based on social class, wealth and occupation.[5] Filarete's Sforzinda, one of the most complete and influential ideal cities ever designed, had eight large neighbourhoods, each with its central market, and two churches shared with adjoining

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1 A stadium was equal to so many braccio (arm's lengths) which could be defined as anything from .545 to .698 metres depending on which town in Italy one was from (see N. Zingarelli (ed.), Vocabolario Della Lingua Italiana. Bologna: 1951, p.151); Filarete, Treatise on Architecture (trans. by J.R. Spencer), London; Yale University Press, 1965.

2 Mumford, op. cit., p.407.

3 See, for example, Stewart (op. cit., p.101).

4 Plato, op. cit., p.383, Book VI, p.481.

5 Rosenau, op. cit., pp.15-17.

neighbourhoods. These neighbourhoods were equally carefully designed whether for the nobility or for the working classes.[1] More's plan for Amaurote, his capital city, was divided into four quarters, each with a central market with shops and stores, and a church. These were further divided into smaller residential sections organised with community dining halls for every sixty houses.[2] Models of the utopian socialists, such as Buckingham's Victoria and Pemberton's Happy Colony, were also divided into residential units. There is some indication that Howard favoured Unwin and Parker's plan for Letchworth over its competitors because it bore strong resemblances to his own "ideal diagram" for a garden city divided into residential wards.[3] Three of these were to focus on centres containing schools, churches, public halls, museums and hotels. The fourth, the town centre, was to focus on a central area with municipal buildings, a post office and churches. There was a separate industrial area and market area. All of these plans, with the exception of More's, placed an emphasis on the central area with most major marketing, religious, governmental and administrative facilities located there. Other special function areas, such as those for sport, industry,marketing and agriculture were variously located about the towns or on their peripheries. Agricultural belts or rings of open space usually surrounded the towns (Figures 2.1-2.6).

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1 Filarete, op. cit.; Mumford, op. cit., p.448. The markets each had a different specialty - straw, wine, and so on.

2 Thomas More, Utopia. London: English Reprints, 1869. Book II, pp. 91, 153. Utopia was a large island on which were a number of towns like Amaurote.

3 C.B. Purdom, op. cit., p.18; also The Building of Satellite Towns. London: J.M. Dent and Sons, Ltd., 1949, p.53. The original Letchworth plan also had much of its area devoted to a radial-concentric 'town centre' similar to Howard's diagram. The Unwin/Parker plan was one of three submitted.

2.2.9 The linear forms in ideal towns, the primary streets, were the organizing features of the towns much as they were in some of the major existing towns. However, their more formal geometric layouts increased this function considerably over the often haphazard existing arrangements. Plato's Atlantis was to have six radial roads from the centre and the six inner neighbourhoods separated from the six outer by a ring road.[1] Vitruvius' plan used the same pattern, but with eight radial streets situated to block the prevailing winds.[2] This also allowed the construction of the two principle streets of the typical Roman colony, the north/south cardo and the east/west decumannus. Filarete's Sforzinda was divided by sixteen 'ways', alternating streets and canals dividing the town into eight neighbourhoods each serviced by a central canal. All of the neighbourhood markets would be on these canals and all would be connected by a ring road.[3] More mentions little about the streets of Amaurote. There are four principle ones from the centre to the periphery which divide the town into the four major residential quarters.[4] The various street patterns of the towns of Howard and the utopian socialists were direct descendants from Filarete's Sforzinda.[5] Howard had his Garden City peripheral industrial areas serviced by a ring railway, but the Letchworth site was split by an existing rail line. Letchworth town centre streets and those of an adjoining sub-area were radial concentric. The other

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1 Plato, op. cit., Book VI, p.481.

2 Rosenau, op. cit., Plate II.b, pp.16-17.

3 Filarete, op. cit., Book V, Folio 44r; Rosenau, op. cit., p.39.

4 Mumford, op. cit., pp.322, 346.

5 Rosenau, op. cit., pp.131-137; Hackett, op. cit., pp.256-259.

three sectors were laid out in rectangular grids[1] (Figures 2.1 - 2.6).

2.2.10 Lesser streets and paths are not featured as prominently as major streets in ideal plans, but they are sometimes mentioned. Plato ignores them but his disciple, Aristotle, thought that lesser streets should be in a loose network like "rows of vines"[2]. Vitruvius mentions the need to protect lesser streets from the prevailing winds.[3] Alberti, who greatly influenced Filarete, advocated that "within the town it is seemly that the road be not straight, but like a river, turning gently first to one side, then to the other".[4] The lesser streets in More's descriptions would organize the rows of houses and units of families for the community dining halls.[5] Howard's Garden City was divided by avenues and roads which seemed part of the main system and his central park was ringed by an enclosed walk. Letchworth "had a number of closes and culs-de-sac".[6] Footpaths were "narrow" and sometimes "omitted".[7]

2.2.11 Thus the areal and linear form elements of ideal towns were similar to those of their real contemporaries. Paradoxically, this is usually cited as a fault of the plans even as their more formal geometric frameworks are often criticised for being too far removed from the situations of the real urban environment. Mumford faults Plato's descriptions as both inadequate and unimaginative since he based most of

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1 Purdom, The Letchworth Achievement, op. cit., pp.16-18.

2 Stewart, op. cit., p.14.

3 Rosenau, op. cit., pp.16-17.

4 Stewart, op. cit., p.105.

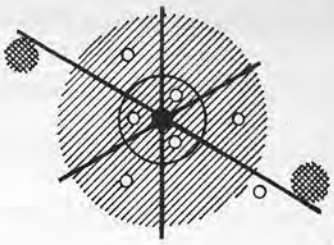
5 More, op. cit., Book II, pp.91, 153.

6 Osborn and Whittick, op. cit., pp.38-40.

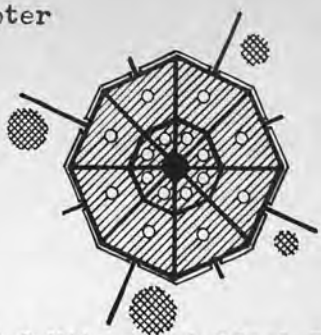
7 Purdom, The Building of Satellite Towns, op. cit., pp.131-135.

Figures 2.1 - 2.6 Ideal Towns

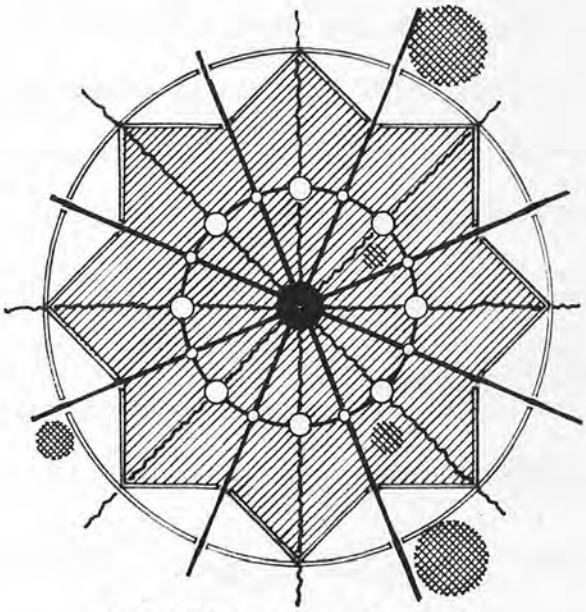
Sources: See footnotes, this Chapter



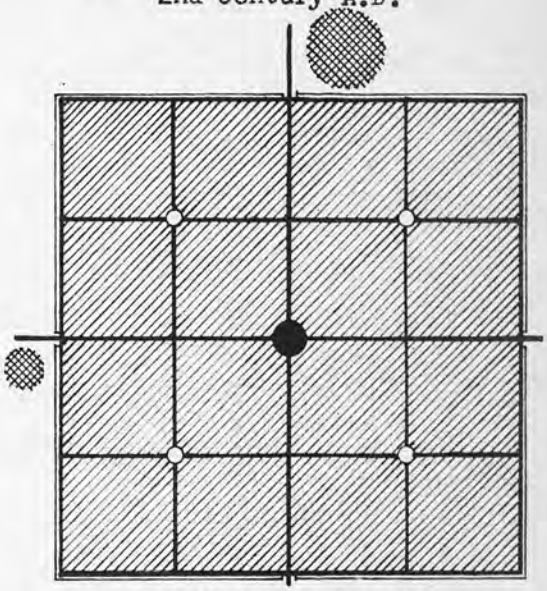
2.1 Plato's Atlantis
5th Century B.C.



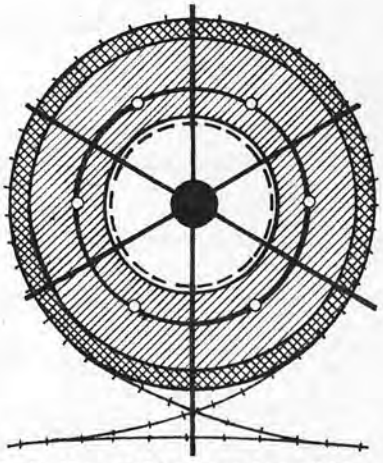
2.2 Vitruvius' Ideal Town
2nd Century A.D.



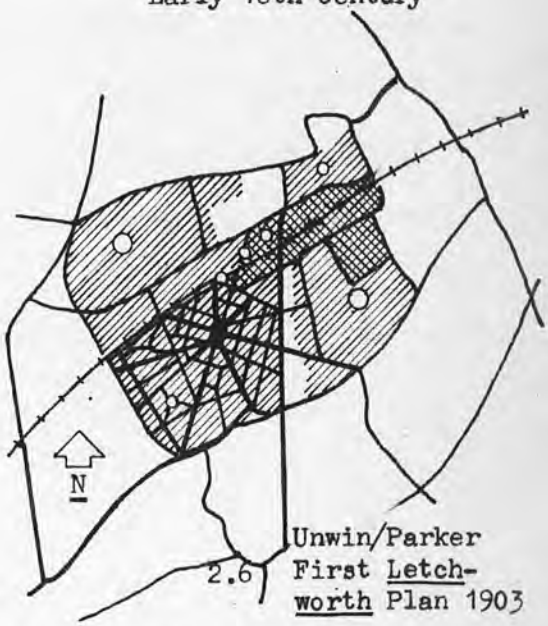
2.3 Filarete's Sforzinda
Mid 15th Century



2.4 More's Amaurote
Early 16th Century



2.5 Howard's Garden City
Late 19th Century



2.6 Unwin/Parker
First Letchworth Plan 1903

All Plans 0 .4 .8 1.2 1.6 kilometres
0 1/4 1/2 3/4 1 mile

Areal Forms
Central Areas ○ Residential Foci ▨ Residential Areas ▩ Industrial Areas □ Open Space

Linear Forms
Major Roads ~ Canals -- Covered Footpath ⊣⊢ Railway ═ Walls

his ideas "on existing urban forms".[1] Conversely, Rosenau states that neither Vitruvius nor Plato designed their ideal towns "on the basis of actual surroundings" but then adds that Vitruvius' treatise is "an accurate reflection of the architectural thought of the times".[2] Mumford notes that Lavedan believed Alberti "did no more than register approval of what he saw under his eyes"[3] and Mumford's criticism of More is that his "images freeze into the forms of his own times".[4] Rosenau quotes Pemberton as admiring radial shapes "because all the grand forms in nature are round", but he also advocated them because "they allow free circulation".[5] Mumford believes Howard did little in "recasting the physical form of the city".[6] The interpretations of these and other writers and the descriptions proffered by the planners of these ideal environments reinforce the idea that the more formal geometric layouts were organizing frameworks for quite ordinary form elements.

2.2.12 There is further evidence to dispute the idea that all ideal town forms were 'unrealistic'. Some, such as Plato's proposals, were planned to be built.[7] Others, such as Palma Nuova, Karlsruhe, New Lanark and Letchworth, actually were built.[8] The concept of ideal towns as *fait accompli* relates to their static forms and fixed populations. However,

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1 Mumford, *op. cit.*, pp.208-10.

2 Rosenau, *op. cit.*, pp.13-17.

3 Mumford, *op. cit.*, p.348.

4 *Ibid.*, p.375.

5 Rosenau, *op. cit.*, p.139.

6 Mumford, *op. cit.*, p.587.

7 Stewart, *op. cit.*, p.6.

8 Zucker, *op. cit.*, pp.209-210; Stewart, *op. cit.*, pp.109-110, pp.143-144.

there was often a detailed diversity of form elements suggested as in the proposals by Vitruvius and Filarete. Some built towns such as Karlsruhe had provisions for expansion.[1] Related to the concept of rigid ideal town plans is the idea of their boring 'goodness'. While there is a preoccupation with the banishment of sin among such planners as More and the utopian socialists this is not always predominant. Vitruvius proposed locations for the temples of Venus, Velean and Mars "so that matrons and youths would not be contaminated with lust".[2] Filarete, more broad-minded, proposed a brothel for the town centre.[3] Howard left the question of 'sin or no sin' up to the inhabitants of the town.[4]

2.2.13 This brief examination of real and ideal town form is not meant to dispute the contention that many ideal proposals were unworkable. It is meant to view some of these proposals as serious attempts to correct problems of urbanization in the man-made environment. It is further meant to show that the forms of these ideal proposals were often attempts to make existing forms workable. The descriptions (not just their interpretations by various writers) show a great deal of concern with environmental form. For social thinkers, such as Plato and More, the forms are in word descriptions since they are more a framework for social ideas. The physical descriptions, when pieced together, are surprisingly complete and coherent, however. Physical planners, such as Vitruvius and

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1 Rosenau, op. cit.; Filarete, op. cit.; Zucker, op. cit., p.209.

2 Vitruvius, The Architecture of Marcus Vitruvius Pollio. (De Architectura Libri Decem) translation by Joseph Gwilt, London: John Weale, 1860, Book I, pp.26, 27.

3 Rosenau, op. cit., p.39.

4 Ebenezer Howard, Garden Cities of Tomorrow. London: Faber and Faber, 1945, p.91.

Filarete, proposed physical forms in more detail as architects' answers to urban problems, but social aspects were not altogether ignored. Finally, the influence of these forms can be found in the plans for the British post-war new towns. Abercrombie's plans for Chipping Ongar which was the prototype for the post-war new towns had school-oriented neighbourhoods, a radial concentric road pattern, a more flexible secondary network with Radburn-type patterns, special areas zoned for industry, special functions and central area functions, and a peripheral green belt.[1] The geneology of this plan extends from Plato's Atlantis to Howard's Letchworth[2] indicating that men have always been aware of the problems of urbanization. The proposals of these ideal forms were a reflection of the workability and order with which they were to guide future urban development.

The Purpose of Urban Form

2.3.1 It has been proposed that man has an intimate relationship with the physical environment, primarily through comprehension of its physical form. It has further been suggested that, as the problems of the man-made environment have become more evident, serious attempts have been made to guide this development by the proposal of ideal models which have sometimes had practical applicability. The form elements of these models, while varying somewhat within the individual proposal, have shown certain consistencies both in their relation to existing developments

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1 Abercrombie, op. cit., pp.33, 111-113.

2 The questions of whether Plato influenced Vitruvius or whether More influenced Howard and so on seem rather pointless. One may find numerous indications in both the original texts (or translations) and in other writers' analyses that show an awareness by each thinker of the ideal plans previously formulated. Mumford believes that Medieval housing groups "anticipated - and indeed even helped to form - the finest efforts of Raymond Unwin and Barry Parker". (op. cit., p.378)

and in their evolution through time.

2.3.2 If it is assumed that the ideal has the function of setting goals giving purpose and direction to workable objectives, rather than actually being attainable, then the functions of ideal towns would seem to be basically the same.[1] The fact that many ideal towns were designed in reaction to specific urban problems and that some were built makes them more viable than many ideals. If the function of environmental form is to provide information about the environment then the ideal form should provide this information in an ideal way.

2.3.3 The ideal towns had their basic form elements rooted in existing conditions. The most ideal of these conditions have drawn comment from several writers. For example, Stewart notes that in the medieval English town of Hereford "wherever there is a vista, there is a terminal feature"[2] but none "of the vistas is very long"[3] so the "local inhabitant would know his way about this labyrinth, but that the stranger, or enemy who had breached the walls, would find himself at a distinct disadvantage".[4]

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[1] This brief description of the function of the ideal is taken from the writer's notes of a lecture given by Professor Reginald Isaacs, Charles Dyer Norton Professor of Regional Planning and Chairman of the Department of City and Regional Planning at Harvard University at a seminar at The University of Rhode Island conducted by the Graduate Curriculum of Community Planning during the spring of 1966. For a viewpoint of the usefulness of a non-ideal approach see William Peterson, "On Some Meanings of 'Planning'", Journal of the American Institute of Planners. May, 1966, pp.130-142. This article assembles and questions much of the current literature on planning theory. Its basic argument is with a narrow, deterministic role of planning. Peterson argues that if the more definite objectives of planning are expanded into platitudinous goals they lose their relevance to the 'real' situation.

[2] Stewart, op. cit., p.76.

[3] Ibid., p.77.

[4] Ibid.

Sitte's work on city planning deals primarily with the function of urban form in organising the medieval city.[1] Schneider and Bacon describe similar effects achieved along the Ishtar Street in Babylon and the Panathenic Way in Athens.[2] Bacon further describes the visual system of axes and termini which Pope Sixtus proposed to reorganize 16th Century Rome.[3] The radial concentric plan, the basic geometric pattern of nearly all ideal towns, was the idealization of this system of vistas. It culminated in the baroque patterns, but in the ideal towns it organized the town as a whole while the smaller residential units, more familiar to those who lived there, had a less regular layout. Sitte suggested that the use of both regular and irregular configurations are appropriate if they give "each district which they lay out an aspect in conformity with its purpose".[4]

2.3.4 Environmental form has had an important role to play in the development of the urban environment and in proposals for solutions to its concomitant problems. Lynch, in his study of urban form, notes that the basic purposes of form information were for "survival", "a sense of place" and "purposeful mobility". He gives numerous examples from primitive societies[5] and suggests that areal form information is still a necessary ingredient of the environment.[6] Morris disputes the applications of such findings from primitive societies to today's more

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1 Camillo Sitte, City Planning According to Artistic Principles. (trans. by Collins and Collins) London: Phaidon Press, 1965. First published in Vienna in 1899.

2 Schneider, op. cit., pp.72-73; Edmund Bacon, Design of Cities. London: Thames and Hudson, 1967, p.117.

3 Bacon, op. cit., pp.126-129.

4 Sitte, op. cit., p.67.

5 Lynch, The Image of the City. Cambridge: Mass.: The M.I.T. Press, 1960, pp.123-139.

6 Ibid., pp.109-120, 127-128.

advanced civilizations[1] but biologists Ardrey and Lorenz have drawn conclusions about similar behaviour in man from the studies of animal societies.[2] Although their findings are criticised as tenuous[3] Ardrey's enunciation of "identity, stimulation and security" as the basic ingredients necessary for the man-made environment are highly coincidental with Lynch's earlier findings on the need for sense of place and survival.[4] Hall, an anthropologist, and Sommer, a psychologist, basically agree with the hypotheses of Ardrey and Lorenz with regard to territorial areas.[5] Morris, a zoologist, suggests that one "of the most important features of the family territory is that it must be easily distinguished in some way from all the others".[6] The weight of these arguments is that the residential unit in some form is still important as an areal element in the modern urban environment.

2.3.5 Lynch thinks, however, that the main function of environmental form, especially in the modern metropolis, is to facilitate purposeful mobility along modern linear networks, much as it had been to facilitate "way finding" in the environment of primitive societies.[7] He believes that this is especially important with "the increasing size of our

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1 Morris, op. cit., p.9.

2 Robert Ardrey, The Territorial Imperative. London Athenium Press, 1966; Lorenz, op. cit.

3 R.A. Hinde, "Agression Again", New Society. 20 Feb., 1969, pp.291-2.

4 Ardrey, op. cit., pp.334-336.

5 Hall, op. cit., passim and "Territorial Needs and Limits", Architectural Design. Nov., 1966, p.536; Robert Sommer, "Personal Space", Journal of the American Institute of Architects. Dec., 1962, pp.81-83.

6 Morris, op. cit., p.160.

7 Lynch, op. cit., pp.124-126.

metropolitan areas and the speed with which we traverse them".[1] Carr's research into the pyschological aspects of linear networks yielded the findings that images of an urban environment outside a neighbourhood or a central area were "built up by the detailed interlocking of sequences - whether automobile or pedestrian".[2] Lee, a psychologist, found in a preliminary investigation that the perceived means of traversing a space, the perceived complexity of the route and the desirability of the goal object determined the choice of route.[3] Sommer, also a psychologist, credits Appleyard's study of urban highway experiences (3.3.3.3, 3.5.2) recording "the visual and kinesthetic sequences of highway travel" as helpful in expressing and refining design alternatives "short of building full-scale roads".[4] These arguments suggest that the expression of linear form is also still highly important as a link between man and the urban environment.

2.3.6 The disciplines of the various writers, biology, zoology, anthropology and psychology, have been emphasised because they deal with the man/environment relationship essentially from what Gump calls an anthropocentric viewpoint - the interaction between the environmental form and the individual. Gump, however, urges an ecological approach which will study not only how the environment tends

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1 Ibid., pp.112-113.

2 S. Carr, "The City of the Mind", Environment for Man. (W. Ewald, ed.) London: Indiana University Press, 1967, p.304.

3 Terence Lee, "Psychology and Living Space", Transactions of the Bartlett Society. Vol.2. London: Bartlett School of Architecture, 1963-64, pp.30-31.

4 R. Sommer, "Can Behavioural Studies be Useful as well as Ornamental?", Transactions of the Bartlett Society. Vol.5. London: Bartlett School of Architecture, 1966-67, pp.52-53.

"to coerce behavior" but how "behavior settings" are created "by inhabitants' en masse behavior coordinated with the physical milieu".[1] Sommer adds that "we must know how the vast majority of ordinary mortals perform in different environments".[2] He points out a number of problems in studying group reactions to the environment including the obvious differences in individual reactions, but concludes that group interaction is more easily and gainfully studied in such situations where "it is nearly impossible to isolate the specific factors responsible for a given outcome".[3] Thus there is also agreement from some of those concerned with individual human reactions that in the study of the physical environment group reactions are a more valid indication of the man/environment relationship.

2.3.7 The disciplines of these writers have also been emphasised because they are not those which are ordinarily thought of as dealing with problems of environmental form. The general definition of form which has been proffered gave its purpose as that of imparting information (2.1.3). It did not say what kinds of information this should be or to what use it should be put. The traditional form-giving disciplines such as architecture and engineering have conventionally proposed purposes for environmental form such as aesthetic enjoyment and functional ordering. While these purposes are commendable, either separately or collectively, they do not seem to be the whole reason for form manipulation. Aesthetic principles have been explained by Arnheim and others as relating

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1 Gump, remarks in reply to Carr, op. cit., p.228.

2 R. Sommer, "Can Behavioral Studies be Useful...?", op. cit., p.56.

3 Ibid., pp.59-62.

to some of man's basic social and psychological needs.[1] The more mechanistic dictum that "form follows function" has been seriously questioned with regard to the man-made environment. Steinitz concludes that form "does not always follow function and functions are not always adaptable to forms. As extensions of architectural design these ideologies fail at the city scale".[2] Research into planning factors affecting the configuration of open space in North American central cities carried out by the writer indicated that this space "has a plethora of 'functions' and a constantly changing form".[3] Pye points out that a thing is never designed for purely functional reasons. He believes that this should be recognized or that 'function' should have an expanded definition including human wants and needs as well as mechanistic requirements.[4]

2.3.8 It is clear that the form of the man-made environment has the same basic purpose of any form - to impart information. This form, although partially an outgrowth of mechanical functions, imparts information about how the environment works in part and as a whole. Man may comprehend this information for aesthetic delight but there are indications that he also uses it for more basic and personal requirements. While few of these requirements are yet understood there is an increasing

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1 Arnheim, op. cit. passim; E.H. Gombrich, Art and Illusion. New York: Pantheon Books, 1962; W.L. Valentine, The Experimental Psychology of Beauty. London: Methuen and Co., Ltd., 1962; Gyorgy Kepes (ed.), Education of Vision. New York: George Braziller, 1965.

2 C. Steinitz, "Meaning and the Congruence of Urban Form and Activity", Journal of the American Institute of Planners. July, 1968, p.247.

3 L. Waters, "A Visual Approach to the Design of Negative Space in the Central City" (Unpublished Masters Thesis) University of Rhode Island, 1966.

4 David Pye, The Nature of Design. London: Studio Vista, 1969, p.8.

awareness of their importance.[1] Carr believes that "we have studied city form but have given very little study to the human half of the equation" yet "it is from such understanding, however limited at first, that we can most effectively develop new hypotheses about what would constitute good city form".[2] Those who have studied the individual in the physical environment believe that this study should be on the basis of group response rather than individual response. It is the general purpose of this study to examine such response to environmental form.

Summary

2.4. Interest in the form of the man-made environment relates to its function of imparting information about the environment. There has always been a close biological relationship between man and the environment and with the growth of urbanization and its concomitant problems, solutions to these problems have been proffered in the form of 'ideal' towns. Their physical forms were usually perfected models of the existing urban environment and were composed of similar form elements. While some proposals were unworkable, others were built indicating that they were more viable than many ideals. Their forms were designed to make them more orderly and comprehensible. Research by a small but growing number of authorities concerned with the individual's relationship to environment indicates that the basic purpose of urban form may be even more important in today's increasingly complex urban conditions.[3]

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1 Kenneth Craik, "The Comprehension of the Everyday Environment", Journal of the American Institute of Planners. January, 1968, p.29; Robert Gutman, "Site Planning and Social Behavior", Journal of Social Sciences. October, 1966, pp.103-115.

2 Carr, op. cit., p.29.

3 A.T.W. Simeons, Man's Presumptuous Brain. London: Longmans, Green & Co. Ltd., 1960. Simeons believes that "the more modern man's cortex drives him out of his natural environment into an artificial one, the more he will become prone to psychosomatic disease". (p.54); Terence Lee, "The Conception of Space and Control of Environment", Arena. Vol.82, No.908, pp.172-175.

CHAPTER III

3.0 This chapter proposes a set of hypotheses on the nature and working of the urban environmental structure, how man gains information about this nature and working through form perception, how this knowledge affects some of his activities, and how it may be edifying for certain societal values. These hypotheses are proposed on the basis of the urban environment as a system - and deal particularly with certain physical sub-systems. The first hypothesis proposes that the form of the urban environment is of a systemic nature. The second hypothesis proposes that these systems are of two general types - areal and linear. The third hypothesis proposes that these form systems have visual characteristics which are comprehended by inhabitants. The final hypothesis proposes that when form elements are more systemically structured the physical environment becomes more useful and edifying.

The Nature of Urban Systems

3.1.1 As an inhabitant of earth man is influenced by two 'macro-systems'. The first is the solar system. The Earth is one part of this system exerting and receiving influences from various other bodies, most notably the sun and Earth's one moon. The second system is the biosphere, described as "a vast web of interacting processes and organisms that form the rhythmic cycles and food chains in which one part of the living environment feeds on another".[1] It is, in effect, the result of the earth's total chemical interactions. However, man has greatly affected the physical composition of the latter

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[1] "The Age of Effluence", Time. 10 May, 1968, pp.42, 43.

system and has taken the first tentative steps toward influencing the former.

3.1.2 By definition a system is a "complex whole, set of connected things or parts, organized body of material or immaterial things".[1] McLoughlin continues:

> Whether we speak of material systems - (central heating system, railway system, manufacturing system) or intangible ones (economic system, political system, classification system) they all satisfy the same definition. They have elements or component parts which are interconnected to form a whole thing with an identity.[2]

There are basically two types of system. The closed or endogenous system is one which functions without any external influences, such as some chemical and thermodynamic systems. In spatial terms the solar system as it now exists is largely a closed system since the actions of its constituent parts are repetitive[3]. The biosphere is an open or exogeneous system since it is subject to spatial change and is made up of a number of sub-systems which influence it and are in turn influenced by it.

3.1.3 The urban environment is one of these sub-systems. Adelman views the city "as a sub-system, as a part of larger systems... urban, regional, state, national, even world".[4] Correspondingly,

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1 The Concise Oxford Dictionary.

2 J.B. McLoughlin, "A Systems Approach to Planning", Town and Country Planning Association. Summer School, Belfast, 9 Sept., 1967, p.2.

3 Save for the odd meteor. The solar system changes through time, however.

4 Maurice Adelman, "The Systems Approach - A Perspective", Ekistics. June, 1967, p.314.

the city also has sub-systems - tangible ones such as schools, streets and roads, intangible ones such as law enforcement, and ones that can be both, such as neighbourhoods.[1] The urban environment, due to its multi-partite nature and systemic relationships, must be considered an exogenous system in spatial terms. The influences acting on and within it and the influences it in turn exerts make it an open system at any point in time.[2] Further, as McLoughlin, Catanese and Steiss point out, a closed system only works, an open system both works and evolves. The constantly changing nature of the urban environment means that the way it 'works' is also continuously changing.[3] Thus the urban environment may be regarded as what Hertz and Bales describe as a "total system".[4] It is a system made up of both tangible and intangible sub-systems; in turn it relates with larger systems (the systems of the total environment) and, finally, it evolves through time.

3.1.4 Viewing the urban environment as a total system has thrown up several basic problems. First, because it has often been thought of as a closed system the urban environment has usually been

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1 Ibid.

2 G.F. Chadwick, "A Systems View of Planning", Journal of the Town Planning Institute. June, 1965.

3 McLoughlin, op. cit., pp. 5-6; also see "Notes on the Nature of Physical Change", Journal of the Town Planning Institute. December 1965, pp. 398, 399. A.J. Catanese and A.W. Steiss, "Systemic Planning", Journal of the Town Planning Institute. July, 1966, pp. 173-174.

4 D.B. Hertz and C.F. Bales, Issue Mapping: A Systems Approach to Urban Administration. New York: McKinsey and Co., Inc., 1967-68 (Research Papers for the City of New York).

planned* on the basis of mechanistic principles.[1] The way many sub-systems 'work' to achieve optimum or minimum mechanistic standards has been the means of achieving a finished product, "a static city".[2] This view is not sufficient for explaining the nature of most intangible systems and many tangible ones which are used in a social context.[3] For example, a neighbourhood system may have all of the required physical facilities on the basis of the size and composition of its population but if these facilities are not located and designed in ways which are conducive to use they will not be used.[4] Facilities will only be used on the basis of the wants and needs of the inhabitants, not on the assumption that a certain number of inhabitants will support a certain number of facilities.[5] Similarly, road systems designed on the basis of assumed peak flows among

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* No distinction is made here between 'planned' and 'grown' cities. Blumenfeld notes that "there are some elements of planning in every city, and none has ever for any length of time followed the original design in every detail." (Hans Blumenfeld, "Theory of City Form, Past and Present", The Modern Metropolis. Cambridge, Mass.: M.I.T. Press, 1967, p.18.

1 Melvin Webber, "Planning in an Environment of Change - Part II: Permissive Planning", Town Planning Review. March, 1968, pp. 280, 281.

2 Robert Mitchell, "The New Frontier in Metropolitan Planning", Journal of the American Institute of Planners. August, 1961, pp. 291-297; Maurice Brown, "The Time Element in Planning", Journal of the Town Planning Institute. September, 1967; Bertram Cross, "The City of Man: A Social Systems Reckoning", Environment for Man. W.R. Ewall, Jr. (ed.) London: Indiana University Press, 1967, pp. 136-156.

3 Catanese and Steiss, op. cit., p.173; McLoughlin, "A Systems Approach to Planning", op. cit., p.6.

4 Robert Gutman, "Site Planning and Social Behaviour", Journal of Social Issues. October, 1966, p.105.

5 Maurice Brown, "Urban Form", Ekistics. June, 1967, p.340.

certain types of land use may be designed out of proportion to actual use.[1] If the variables affecting the system are changed such as a large number of inhabitants who account for 'passenger-car-units'(7.3.3.1) taking another route, the system does not 'work' in terms of its intended standards. Even a closed, mechanical system, such as a water supply system, is not entirely free from the influences of human activity.

3.1.5 The second problem of the total systemic view is that urban sub-systems rarely work independently. "Because the elements of a system (whatever it may be) are interconnected, disturbances arising inside or outside the system and impinging on any point or sector will cause repercussions on other elements..."[2] Decisions about classroom size based on principles of an educational system can affect the movement systems in school buildings and cost accounting systems in the construction industry. The failure to provide stimulating neighbourhood systems may have adverse effects on the community social system.[3] The confusion at a traffic junction can interrupt or slow down traffic on other parts of the road system. In a total system such as the urban environment these interrelated effects can be within a sub-system or between sub-systems.

3.1.6 A final basic problem of a total system is that it evolves. This change again sets the environmental system apart from one that

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1 McLoughlin, "A Systems Approach to Planning", op. cit., p.5.

2 Ibid., p.2.

3 A.E. Parr, "Psychological Aspects of Urbanology", Ekistics. March, 1967, p.162.

is more closed and mechanical in nature.[1] This evolutionary change - that is, one to a higher and more complex order - also introduces certain problems affecting the nature of the various sub-systems. If inhabitants are taken from a neighbourhood system and put into a more limited residential system or if a road system obliterates a neighbourhood system then the inhabitants suffer.[2] A utility system may not be able to expand to meet the needs of a residential system. Advancing technology in information communications systems may effect radical changes in social systems.[3] This growth to higher and more complex order is intrinsic to the nature of the urban environment because most of its sub-systems are 'large' in the sense of having many intricate components;[4] their evolution involves many complex interactions.

3.1.7 These three problems of the urban environmental system, its openness to external influences, the interdependence of its sub-systems and their various parts, and its evolution to a higher, more complex ordering, all have implications for the primary subjects of this study - physical form and its human inhabitants. Planning

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1 McLoughlin, "A Systems Approach to Planning", op. cit., pp.7-9, "Notes on the Nature of Physical Change", op. cit., pp. 398, 399; Chadwick, op. cit., pp. 184, 185.

2 Marc Fried, "Grieving for a Lost Home", The Urban Condition. Leonard Duhl (ed.), New York: Basic Books, 1963, pp. 151-171; Lewis Mumford, The Highway and the City. New York: The New American Library, 1963.

3 M.M. Webber, "Order in Diversity: Community Without Propinquity", Cities and Space. L. Wingo; Jr. (ed.), Baltimore: The Johns Hopkins Press, 1963; Richard Meier, A Communications Theory of Urban Growth. Cambridge, Mass.: The M.I.T. Press, 1962.

4 W. Ross Ashby, An Introduction to Cybernetics. London: University Paperbacks, Methuen and Co., 1964, pp.60-65.

the urban environment as a closed mechanical system has often led to the design of physical sub-systems based on mechanical criteria and standards with little regard for the nature of their total and possibly highly varied uses or for the idiosyncracies of their human users.[1] Planning each sub-system or its components as separate items ignores the fact that these parts and systems are made interdependent primarily by the activities of their users and often secondarily by their competition for resources, such as physical space. Finally, the activities of users and the resources available for their working may change much faster and evolve much more complex patterns than the physical structure can handle. This is particularly true if the systems or their parts have been planned to reach some 'final' state or condition of operation.

3.1.8 Yet the physical structure and the human user are possibly the most 'constant' factors in the urban environmental system. The physical structure, whatever its nature, is the container for activities and, as such, should be the end result of planning for activities.[2] Its utilization of physical resources, which are 'expensive' in monetary terms, and its more permanent nature in spatial and social terms mean that it cannot always change as rapidly as the activities which it serves. The instigator of these activities, the human society, is made up of individuals whose collective action,

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[1] For a discussion of extraneous factors of 'scientific' origin and their influence on systems planning see John W. Dyckman, "City Planning and the Treasury of Science", Environment for Man. W. Ewald, Jr. (ed.), London: Indiana University Press, 1967, pp. 27-59.

[2] Colin Buchanan and Partners, "South Hampshire Study", Ekistics. June, 1967, pp. 316-328. "Structure is the physical environment; system is the fusion of the physical environment with the activities and processes appropriate to it." (p.317)

while constantly evolving, retains some relatively slow-changing characteristics (2.3.4-2.3.5). It has been proposed that one of the major links between the human organism and the physical environment is the perception and comprehension of the environmental form by visual means. It has further been proposed that this comprehension is more important in today's increasingly complex urban environment than it was in more primitive environments. If the nature of the urban environment is systemic then its comprehension and use by its human inhabitants should also be on a systemic basis.[1] This study will examine both the visual forms of particular mechanical/human and human physical sub-systems of a particular urban environment and human interaction with these forms. It will do this by testing four general hypotheses relating systemic form and human activity.

Hypothesis 1: The physical form of the urban environment is of a systemic nature.

3.2.0 The argument for this hypothesis rests on three premises: 1) it is inherent in human nature to plan and design the physical parts of the urban environment as sub-systems; 2) the forms of these sub-systems are related by being parts of a system; 3) inhabitants perceive these related forms. This argument that forms are designed and connected as form systems and perceived as form complexes indicates the reasons or tendency for form systems to exist. It does not, however, indicate that the forms are structured and used as form systems by the inhabitants.

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[1] C.F. Chadwick, "Some Thoughts on the Application of the Law of Requisite Variety", Journal of the Town Planning Institute. January, 1970, p.3, para.2.

Conscious Systemic Design

3.2.1.1 Some physical theories of the universe suggest that "the general trend of physical events is toward states of maximum disorder".[1] As a principle of thermodynamics this is arguable, but it does not seem to apply to collective human activity, particularly to that of 'planned' human activity. The studies of post-Darwinism have suggested that this activity can subsequently be broken down to a series of atomic and molecular chemical actions whose physical changes are the cause for all human behaviour.[2] Whether this is a valid analytical expression or not the collective result of individual human behaviour definitely tends toward order.[3]

3.2.1.2 If this is true for societal behaviour then it should be true for the types of environment which societies build for themselves. Ling argues that "Urban form has changed as social, economic and technological conditions have advanced."[4] If human societies tend toward order then it follows that they would not construct an environment which would impede this order. Some indications of urban growth suggest that they have (1.1.5-1.1.8). There is, however, more order in the environment than is often apparent to some observers. To quote Reichek:

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1 Catanese and Steiss, op. cit., p.173.

2 John Davy, "The Evolution of Evolution", Observer Magazine. 8 February, 1970, p.10.

3 Michael Argyle, The Psychology of Interpersonal Behaviour. Pelican, 1967, pp. 13-30.

4 Arthur Ling, "Urban Form or Chaos?", Journal of the Town Planning Institute. March, 1967, p.87.

> We claim that our cities have no order - no structure. I say that this is not so. Our cities do have an order. That which is without order cannot be thought of or objectively seen. Where there is no order, perception and recognition is not possible. When we cry 'no order' we are in fact saying that we do not know what the order is.[1]

Often what seems to be a chaotic physical situation has more order than is at first apparent. Banham argues that the confusion supposedly engendered by the Los Angeles Freeway system is exaggerated and that it actually is fairly easily used and works quite well in the movement and distribution of vehicular traffic.[2] In the urban environment there are many inherent systemic organizations, but these are not always recognizable.

3.2.1.3 Much of the urban physical environment is designed as a series of sub-systems. These can take three classifications. Purely mechanical systems are those which are closed (endogenous) such as water systems, waste systems, power systems, some goods delivery systems and so on. Although these are designed for human demands they are by nature continuous and not directly influenced in their basic functioning by societal action. Mechanical/human systems are those which use mechanical facilities but are influenced by societal action, such as transport systems or information communications systems. Here the system may be dependent upon mechanical facilities, but it is more dependent upon how humans use these facilities. Finally, there is the human system such as the neighbour-

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1 Jesse Reichek, "Additional Remarks on the Design of Cities", Transactions of the Bartlett Society. Vol. 5, 1966-67, p.71.

2 Reyner Banham, "Encounter with Sunset Boulevard", The Listener. 22 August, 1968, p.236; "Roadscape with Rusting Rails", The Listener. 29 August, 1968, p.268.

hood or education system. Its physical systems are 'connected' primarily by the activities and values of its users.

3.2.1.4 These physical systems are often consciously designed to work in a systemic way. The well-functioning of a mechanical system depends upon the correct interconnection of all of its parts. The mechanical/human system depends upon both its mechanical parts and the correct human use of these parts for its working. The human system depends primarily upon human interaction at a level sufficient to give beneficial results to the society or population which constitutes it; this partly depends on the well-functioning and location of its constituent physical facilities. Trouble with any parts of these systems will affect the whole system and have implications for any interconnecting systems.

Systemic Tendencies of Forms

3.2.2.1 The most perceivable and comprehensible aspects of a system are the shapes of its constituent parts (2.1.3). Because each of these parts plays a role in the total functioning of the system it follows that each must be formed both to perform its individual task and as a part of the system. Mechanical systems are a good example of this. Each part of a water supply system has a particular function. The shapes of valves are governed by their need to regulate water flow, the shapes of meters by their need to measure flow and the shapes of pumps by their need to increase this flow. All parts of the system, however, have a primary function - to carry water - and the shapes of all parts including intake pipes, joints and taps are governed by this systemic function as well as by their individual functions.

3.2.2.2 The shapes of a mechanical system, even when they are visible, do not play much of a part in imparting needed information about the system since these systems are not usually subject to societal influences. The shapes of mechanical/human and human physical structures are somewhat different, however. In the case of a mechanical/human system, such as a road system, the function of an interchange may be thought of as: 1) particular function - to offer changes of direction for human travel*, 2) systemic function - to 'channel' (contain and direct) human travel. Thus the shape of an intersection must serve both functions; it must offer opportunities for changes of direction in human travel while continuing to channel this travel. The physical structures of human systems are shaped for their individual purposes but the relation of forms within the system may vary. If it is a 'clustered' system, such as a residential unit, then the shapes of its parts would need to interconnect with or 'belong to' the system in some ordered way while still allowing for connections to other systems such as roads and footpaths. An example of this would be a series of numbered row houses on a street. If, however, a human system is 'linear/nodal', such as a school system, then each unit would have to be shaped to accommodate its linear connections (lines of idea communication, transport and supply) as well as its more contained, individual functions.

3.2.2.3 If a system is consciously designed as such or is used as such by inhabitants then its parts are related. The relationship of parts means that their shapes or forms are also related by being

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* Even goods travel, in this case, is under human control.

a collection of external appearances of the same system. Whatever the individual role of a component and its shape to fit that role the shape should also bear some relation to the system or be comprehended as some visual expression of its systemic purpose as well. This should be particularly true in mechanical/human or human physical systems where the forms of a system may be consciously related for individual or societal purposes.

The Perception of Related Forms

3.2.3.1 The argument has been advanced that vision is the strongest and most constant link between man and his physical environment (2.1.2-2.1.4). It is primarily by vision that he judges the relationships of forms. Conscious attempts have been made to organize form systems related to physical systems which were visual in character, but these attempts were formulated not by those who use the physical system but by those who were responsible for its design and mechanical functioning (2.3.7). There is evidence, however, that users can and do comprehend the visual interrelationships of form complexes.

3.2.3.2 In 1960 Lynch wrote in the preface to The Image of the City that the book was about "the look of cities", but it actually deals with how people use the city image.[1] Lynch chose three cities with rather diverse form developments and made visual surveys of the

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[1] Kevin Lynch, The Image of the City. Cambridge, Mass.: The M.I.T. Press, 1960, p. v and pp. 2-3.

downtown areas of each.[1] He compared these surveys with personal interviews to ascertain to what extent his visual analysis was valid in terms of the way users saw the same forms. He found that within the limits of his personal interview sample (small and unbalanced with regard to age, sex and social class[2]) the visual analysis of elements was similar to that of the inhabitants.

3.2.3.3 Lynch's study implied another interesting possibility, however. While noting that "there was a lack of information on element interrelations, patterns, sequences and wholes"[3] he found that "most observers seem to group their elements into intermediate organizations which might be called complexes. The observer senses the complex as a whole whose parts are interdependent and are relatively fixed in relation to each other."[4] This implies that within the limits of Lynch's interview sample people who use the physical environment tend to comprehend it as related forms. Lynch further found the tendency to recognize related environmental forms was so strong that even in a city like Jersey City with its relatively low imageability "manifested in dissatisfaction, poor orientation, and an inability (of the residents) to describe or differentiate its

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1 The three cities were: Boston, a city with strong traditions and history, many historical structures and, particularly in the central area, a rather random street pattern; Jersey City, New Jersey, an industrial and rail centre close to New York City which has practically no tradition, little colourful history and, essentially, a grid street pattern in the central area which is cut into odd-shaped sections by larger roads and railways; Los Angeles, a city with its traditions and history nearly lost by rapid horizontal expansion which has a central area of a rather wide grid of streets within a larger framework of 'freeways'.

2 Ibid., pp. 152-3.

3 Ibid., p. 155.

4 Ibid., pp. 84-5. Compare this description with the definitions of systems (3.0.2).

parts" the "chaotic set of surroundings does in fact have some pattern and people seize upon and elaborate this pattern".[1] Lynch concludes that "Jersey City is a long step from pure chaos. If it were not, it would be uninhabitable".[2]

Summary - Hypothesis 1

3.2.4 The argument has been advanced that the form of the physical environment, particularly that of the man-made environment, is of a systemic nature on the basis of certain assumptions and recent research results. The environment in general and the man-made physical environment in particular work as systems. If the environment did not function with some order it could not be comprehended and used. Man consciously organizes many of the constituent parts of the physical environment as sub-systems. Due to the systemic nature of the environment and this conscious organization of its physical sub-systems, the forms of these systems also tend to be related. Lynch has shown that a certain class of users of these forms see them as related and that they perceive order even when it is weakly designed or not designed at all. He advances the argument that if this organization is not present, apparent and comprehended the environment becomes uninhabitable. The prime contention of this study is that forms tend to be systemic due to their design, function and comprehension as such.

Hypothesis 2: Form systems are of two general types: areal and linear.

3.3.0 This hypothesis assumes that physical form systems -

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1 Ibid., p.32.

2 Ibid., p.115. Compare this with Reichek's statement (3.1.2).

defined as the related shpaes of interrelated systemic parts - are more dependent for this interrelationship on the activities or movement within the system than upon the actual physical structure of the system. This assumption is based upon the following premises. First, a consciously designed system, such as a road or neighbourhood system, is planned with some of the basic or peak activities of the user in mind. Second, where the structure does not fit the activities the activities will predominate. Finally, as Lynch discovered, forms will be put together in some sort of pattern even when not designed this way. An examination of form systems must thus be related to patterns of activity as well as to how the system has been designed. This hypothesis examines general human activity patterns and their implications for form systems.

Systemic Activity

3.3.1.1 Chadwick, in writing on systems, notes:

> that a town as a physical artifact is not a system: it is that only when the buildings are occupied by people's activities; when the services flow in the town; when the spaces and channels are filled with flows and movements of people and goods and information; when there is a daily and weekly and seasonal change in these activities and flows; when the whole situation ages or changes in longer periods of time - only then is a town a system.[1]

The writer disagrees with Chadwick about the physical town not being a system. A water system does not actually have to carry water to be considered a system for that purpose; a house is a physical system for residential activities, whether it is lived in or not. However, the most obvious way to determine the viability of a system is

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[1] Chadwick, "A Systems View of Planning", op. cit., p.185.

to assess its activity.[1]

3.3.1.2 In an article on urban form Lynch and Rodwin noted that "understanding the varied effects of different physical forms, and ....the locations of human activities in relation to physical forms is, or should be, the principle analytical skill of the physical planner".[2] Steinitz found that "the form image is likely to be of most use....when it reinforces actual activity distinctions".[3] This implies that any form system should be primarily based on, and oriented toward, an activity system. He further found that "when form does not visually express the activity pattern, the activity pattern with its subtler distinctions will not only dominate a person's meaningful knowledge, it may well eliminate form attributes from consideration."[4] This suggests that when a system, even if consciously designed, does not satisfy or correspond to an activity pattern then it ceases to function as a system or only functions weakly. Lynch's findings on Newark, however, suggest that in the absence of a designed form system or the disuse of a system by the users, new forms will (and must) take their places to correspond to the activity pattern. Activity seems to be the prime determinate

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1 Meier's (op. cit.) definition of a city is "a contrived system to expedite human transactions". Also see C. Alexander, "The City as a Mechanism for Sustaining Human Contact", Environment for Man. W. Ewald, Jr. (ed.) (op. cit.), pp. 60-109.

2 Kevin Lynch and Lloyd Rodwin, "A Theory of Urban Form", Journal of the American Institute of Planners. Vol. 24, no. 4, 1958, p.201.

3 C. Steinitz, "Meaning and the Congruence of Urban Form and Activity", Journal of the American Institute of Planners. July, 1968, p.244.

4 Ibid.

of systemic use and form system organization.

3.3.1.3 There are indications that this activity takes two basic patterns: areal and linear. Although Lynch and Rodwin did not actually analyse activity-form relationships, they did suggest that "a system for activity pattern would probably require a description of two basic aspects: flow of men and goods on the one hand, and, on the other, the spatial pattern of more localized activities such as exchange, recreation, sleeping, or production".[1] Chadwick acknowledges that these two activity patterns have validity for systemic structure when he discusses the "spaces and channels" being filled with "flows and movements of people" (3.3.1.1). McLoughlin adds the idea that the structure of society refers to "the actions of individuals or groups within society seeking competitive advantage by the adaptation of space to particular activities."[2] He further believes that these actions within adapted specialized spaces are tied together by "the interconnections we know as material flows of goods, persons or messages and non-material flows of information or energy."[3]

3.3.1.4 This study will examine three physical systems common to the urban environment which accommodate human activity. Two are linear. The road system although mechanical/human is usually more mechanically oriented for it accommodates human activity by mechanical means. The pedestrian system usually does not use

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1 Lynch and Rodwin, op. cit., p.204.

2 McLoughlin, "Notes on the Nature of Physical Change", op. cit., p.398, para. 3.

3 Ibid., para. 9.

mechanical aids but may be laid out by mechanistic standards, often contiguous with the road system. The third system is areal. The neighbourhood system is based on somewhat diverse human activities but may be planned with a more formalized structure (e.g., the neighbourhood 'unit') to accommodate these activities. The linear systems usually have well defined physical structures but the neighbourhood system may not be consciously designed or 'fit' the more formalized planned structure and, consequently, is harder to define.[1]

Areal Systems

3.3.2.1 Areal systems are the locations of, and structure for, localized, grouped activities (activities which are primarily time-sequential and space static). The formalized physical structure provided for these activities is often termed the neighbourhood unit. This system, first developed in physical form[2] by Perry in 1923, was actually a model based on his own community.[3] The scheme was centred on the primary school and community centre and discouraged through vehicular traffic. It was bounded by vehicular routes on all sides and had shopping centres located at some junctions of these routes.[4] The basic concept was applied in Stein's and Wright's work

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1 Dan Waldorf, "Neighbourhood Unit Assessments - Simple or Complex?", Official Architecture and Planning. March, 1967, p.373.

2 Perry developed his proposals for the 1929 New York city Regional Plan based on some earlier (1910 - 1923) ideas he had developed but the 'community unit' idea may have originally been proposed by a Chicago sociologist, Harriett Martineau in 1874.

3 Waldorf, op. cit., pp.372, 375.

4 Clarence Perry, "The Neighborhood Unit", The Regional Plan of New York and its Environs. New York: 1929.

in the United States[1] and, to some extent, in early planned developments in Britain and elsewhere. The idea was basic to the design of Chipping Ongar (2.2.13) and the early new towns, usually with populations needed to support a 'one stream' or 'two stream' primary school (5,000 - 10,000 people). There have been a number of recent measurements of different sizes and types of 'neighbourhoods' based on different criteria and made in different situations.[2] Still other studies have claimed to find no positive identification of urban sub-areas[3] and some authoritative sociologists say they are disappearing or do not exist as socio-physical units.[4] Perhaps the most realistic statement concerning neighbourhoods is that they "are much more complex and various than both sociologists and planners have thought."[5]

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1 C.S. Stein, Toward New Towns for America. Cambridge, Mass.: The M.I.T. Press (1957), 1966.

2 Peter Willmott, "Housing Density and Town Design in a New Town", Town Planning Review. July, 1962, pp.115-127; Elizabeth Gittus, "An Experiment in the Identification of Urban Sub-areas", Transactions of the Bartlett Society. Volume 2, 1964-65, pp.108-135; Terence Lee, "Psychology and Living Space", Transactions of the Bartlett Society. Volume 2, 1964-65, pp.34-36; Peter Willmott, "Social Research in New Communities", Journal of the American Institute of Planners. November, 1967, pp.393, 394.

3 Waldorf, op. cit., p.277, footnote 16.

4 Melvin Webber, op. cit. and "The Urban Place and the Nonplace Urban Realm", Explorations into Urban Structure. M. Webber (ed.), Philadelphia: University of Pennsylvania Press, 1963, pp.79-153; Harold Orlans, A Sociological Study of a New Town. London: Routledge and Kegan Paul, Ltd., 1952, pp.100, 101. Orlans does not believe that different residential physical patterns will have different effects on the "welfare" of the inhabitants; Herbert Gans, People and Plans: Essays on Urban Problems and Solutions. New York: Basic Books, 1968. See especially "Environment and Behavior".

5 Waldorf, op. cit., p.377.

3.3.2.2 Part of this division of opinion is due to sub-areas not being used as a basis for analysis[1] which in turn is due to some doubt about what activities or purposes the neighbourhood unit should serve. Waldorf thinks that a neighbourhood should be studied from three aspects: 1) to foster "close social relationships", 2) for services "for all age groups", 3) "as a political unit of self-government".[2] These basically are the aims which Perry set for it.[3] However, Orlans disputed that any of these aims had been accomplished in the larger neighbourhood units of Stevenage.[4] Willimott found that most residents of Stevenage tended to name a much smaller residential unit as their neighbourhood and a study by Willis of a number of recent research documents concluded that "the neighbourhood in sociological terms is a small group of people who have a direct relationship with each other".[5] Lee found that most inhabitants in Cambridge identified an area of under 100 acres (42 hectares).[6] He suggested that an area of 75 acres (31 hectares) is "fairly constant" for this identity.[7] Willmott found that 58% of those interviewed in Ipswich identified an area of 100 acres or less.[8] Areas of 75-100

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1 Ibid., p.375.

2 Ibid., p.377.

3 Robert Gutman, "Site Planning and Social Behaviour", Ekistics. March, 1967, p.166.

4 Orlans, op. cit., p.99.

5 Margaret Willis, "Sociological Aspects of Urban Structure", Town Planning Review. March, 1968, p.304.

6 Lee, op. cit., p.37.

7 Willis, op. cit., p.303.

8 Shankland, Cox and Associates, Expansion of Ipswich. Designation Proposals to the M.H.L.G. 1966. Appendix 'C', Table 9.

acres are about the size of units with 2,500-5,000 inhabitants or from 800 to 1,600 families. However, Willmott believes that "small clusters of dwellings (up to 20 or 30) should be given a clear identity and coherence, and designed so that access routes encourage frequent casual contact".[1] Willis' research showed that provisions for such clusters in some British new towns range from 12-60 units.[2] These figures are close to Chapman's figure of 40-100 families which he believes is good for "face to face contact" and to "throw up natural leaders".[3] There are various estimates in the sources cited for groups of 100-200, 200-400, 400-600, and 600-1,400 families for various purposes from 'keeping a sense of place' to 'supporting local services'.[4]

3.3.2.3 The sizes of 'neighbourhoods' or local areas may correspond to a number of criteria held by planners, sociologists or inhabitants. Although the sizes of residential sub-units may vary in terms of physical size and population, and their social and service functions may vary, some research shows that people can identify these units and that they are often physically structured for various

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1 Willmott, "Ipswich Expansion - Social Aspects of Design and Management", Unpublished working paper sent the writer dated 14th June, 1966. Willmott has added the proviso that some routes should not encourage contact; that there should be both "privacy" and "sociability" (Letter dated 14 April, 1970).

2 Willis, op. cit., pp.301-304.

3 Dennis Chapman, "Social Aspects of Town Planning", The Architects' Journal. 30 Sept., 1948, p.316.

4 See, for example, "Washington: A Landmark in New Town Design?" Official Architecture and Planning. March, 1967, pp.379-381 (under 'Village Units'). These figures are purportedly based on "sociological research" which the designers' sociologist says is that of Terence Lee (letter to the writer from Llewelyn-Davis, Weeks and Partners dated 12 November, 1968).

purposes. Willmott noted that although the sizes of Ipswich neighbourhoods varied widely "there was nevertheless high consensus about certain boundaries and that these boundaries are mainly physical features".[1] Lynch found that areas were highly identifiable parts of the city structure.[2] Further, on the basis of activity, Steinitz found that they are the most "meaningful" parts of urban structure.[3] Michelson adds that "a distribution of types of desirable spatial separations for the city's residents should be considered by designers".[4] These studies suggest that areal systems do exist, that they vary in size and complexity for different purposes and are physically structured by the activities of inhabitants.

3.3.2.4 It is proposed that the purpose of the areal form system is to locate and facilitate areal activities by identifying their foci, extents and structure. Lynch, in discussing districts, noted that they "are relatively large city areas, which the observer can mentally go inside of, and which have some common character".[5] They can have both 'hard' and 'soft' edges or no edges at all. He found that "these edges seem to play a secondary role: they may set limits to a district, and may reinforce its identity, but they apparently have less to do with constituting it".[6] He surmised that when the

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1 Shankland, Cox, op. cit. Appendix 'C'-5, para. 8.

2 Lynch, op. cit., pp.66-72.

3 Steinitz, op. cit., p.24.

4 William Michelson, "Urban Sociology as an Aid to Urban Physical Development: Some Research Strategies", Journal of the American Institute of Planners. March, 1968, p.106.

5 Lynch, op. cit., p.66.

6 Ibid., p.70.

areas overlapped or were connected to other city elements the edges "should be penetrable: a seam, not a barrier".[1] He further suggested that areas were 'thematic units'[2] and believed that a district was organized around a strong node. Even if its identity gradually faded toward its outer extent it should have a certain 'theme' throughout.[3] Finally, Lynch thought that such a 'thematic unit' was strongest when made up of several characteristics, such as physical details, activity types, social classes or ethnic groups.[4] Steinitz' findings on the use frequency of areal structure corroborated Lynch's findings in terms of activity.[5]

3.3.2.5 This concept of thematic units is a useful one from several aspects. First, it defines the locus of an area, but does not give it any 'standard' size or fixed boundary characteristics. Second, it would seem to accommodate a number of differing internal characteristics as suggested by Lynch within an area which retains its homogeneity. Third, although it would accommodate the mix, movement and overlap of activities by having penetrable boundaries, the foci[6] of

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1 Ibid., p.104.

2 Ibid., p.70.

3 Ibid., pp.67, 68, 101, 102.

4 Lynch noted that some of these areas had "little perceptual content" (Ibid., p.70).

5 Steinitz, op. cit., pp.243-247.

6 Little has been written on the idea of social foci. One interesting article dealing with this idea in architectural space is Robert Sommer and Gwynneth Witney Gilliland, "Design for Friendship", Journal of the American Institute of Architects. December, 1962, pp.84-6. They suggest that space should be "sociopetal" or designed to draw attention to a centre rather than "sociofugal" or space that discourages interaction between people.

these activities would furnish unit locational identity.[1] The principle of areal form systems is suggested as thematic structure. In areal form systems the problem would be to find out how the thematic unit is structured for human usage and comprehension.

Linear Systems

3.3.3.1 Unlike areal systems the structures of linear systems are usually well defined physically. The linear systems examined in this study, roads and pedestrian routes, are to direct and, to some extent, contain and regulate human activity (which is both time-sequential and space-sequential extended flow activity). The linear structure has always been a reflection of its activities even though not always formally structured:

> From the Roman road to the modern arterial highway, from the crabbed lanes of tenth century Paris to the Bantu pathways through the jungle, the street occurs again and again as a principle through which man attempts to bring order to his existence, to make a chaotic and often hostile world habitable and intelligible.[2]

Road systems have received special attention in physical planning, particularly in highly industrialized countries with a high rate-of-growth of car ownership. The problems of road usage in the urban environment and their adverse effects on urban sub-areas have also

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[1] It can also correspond to characteristics which have been determined in the extensively studied areal systems of locational analysis in regional studies including the hierarchial distribution of nodes. See for example, Peter Haggett, Locational Analysis in Human Geography. London: Edward Arnold, Ltd., 1965, esp. pp.17-19.

[2] Donald Barthelme, "Growit Yourself College", 10 Designs, Community Colleges. Houston: Rice University Department of Architecture, 1962, pp.48, 49.

received considerable attention.[1] The separation of pedestrian and vehicular routes was accomplished to some extent in the British post-war new towns and certain 'pedestrian precincts' were created, primarily in shopping areas.[2] The measures have been implemented in existing towns to some extent.[3] Adaptation of the 'Radburn Plan' to the new towns further structured the separation of routes in the housing areas.[4]

3.3.3.2 The most complete investigation of urban linear activities to this writer's knowledge has been carried out by Hillman at the University of Edinburgh concurrent with this study.[5] Hillman's study suggests a much more time-and-space extensive use of linear facilities by people of all ages than has heretofore been assumed. This is particularly true of so-called non-design or 'off-peak' flows by public transport and on foot. Hillman suggests that as car travel continues to increase along vehicular routes designed for journey-to work or major origin-destination flows this

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1 Traffic in Towns. London: H.M.S.O., 1963, especially pp.60-76 (Penguin, 1964); Colin Buchanan, The Mixed Blessing. London: Leonard Hill, 1958; M.H.L.G. Roads in Urban Areas. London: H.M.S.O., 1966.

2 Ibid.; Osborn and Whittick, The New Towns - The Answer to Megalopolis. London: Leonard Hill, 1963.

3 There are numerous schemes of this sort in older towns. For one of the most successful see: Norwich - The Creation of a Foot Street. Norwich: Norwich Corporation, 1969 (28 pp.).

4 Osborn and Whittick, op. cit. passim, A. Miller, Radburn and Its Validity Today. M.P.B.W., Building Research Station Current Paper 36/39.

5 See also: Sir Alker Tripp, Road Traffic and its Control. London: Edward Arnold Ltd., 1950 and Town Planning and Road Traffic. London: Edward Arnold Ltd., 1942; Paul Ritter, Planning for Man and Motor. London: Pergammon Press, 1964.

traffic interferes with and considerably curtails the movements of pedestrians and public transport users. Hillman found in a travel survey in Stevenage new town that all but the very youngest (0-4 age group) and oldest (over 60) had relatively constant rates of travel activity and that generally the time taken for travel by those individuals in car and non-car households was not significantly different. Finally he found that a journey's visual interest was nearly as important as the effort of undertaking it and approximately 2/3 as important as time or cost considerations.[1]

3.3.3.3 Lynch's study suggested that most inhabitants organize the environment by means of pedestrian and vehicular paths.[2] Appleyard, Lynch and Myer believe that form elements can be as important or more important in many respects for urban road design as the more mechanistic engineering standards - even to the extent of determining road location.[3] Steinitz found paths as well as areas important in the structuring of the environment, particularly in relation to visual comprehension, but he particularly found that pedestrian exposure "was the most important determinant of a person's knowledge, both about the form itself and about the attributes of its activity".[4] He further found that "neither vehicular views nor transit views

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1 Mayer Hillman, "Mobility in New Towns", (research work on a Ph.D. thesis) Edinburgh: University of Edinburgh, Department of Urban Design and Regional Planning, 1970.

2 Lynch, op. cit., pp.49-66.

3 Steinitz, op. cit., footnote 7. Appleyard, Lynch and Myer, The View from the Road: Cambridge, Mass.: The M.I.T. Press, 1964.

4 Steinitz, op. cit., p.243.

generally exposed the more important places in Boston's central area".[1] This agrees with Lynch's study which was basically done by charting details at the pedestrian scale, part of which covered the same area (downtown Boston) as Steinitz's study. To some extent these findings support Hillman's contention that more emphasis should be put on non-vehicular activities.[2] The Lynch and Appleyard studies suggest that this structuring is also important for road systems.

3.3.3.4 It is proposed that the purpose of linear form systems is to locate linear activities and to help direct, contain and regulate them by making the linear relationships of their constituent parts apparent and comprehensible. Most of the form elements which Lynch proposed, landmarks, nodes and edges, relate to linear as well as to areal forms. The examination of linear activities suggest that for any linear system it is important to identify the destinations (nodes) and the structure of the system leading to them (paths, landmarks, other nodes, edges). The purpose of the activity is to reach some number of desired locations by the most rewarding routes. Whatever this may mean in terms of mode of travel, time, cost, safety, effort and interest there are indications that the physical structure of the route and the perception of its forms are essential in making this value judgement (2.3.5).[3]

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1 Ibid., p.240.

2 D.H. Carson, "Comments on 'The Pattern of Streets'", Journal of the American Institute of Planners. Nov., 1967, pp.409-11; D.G. Stuart, "Planning for Pedestrians", Journal of the American Institute of Planners. January, 1968, pp.37-41.

3 Terence Lee, "The Conception of Space and Control of Environment", Arena. Vol. 82, no. 908, p.174.

3.3.3.5 Linear systems are flow systems and their physical structures are to direct, contain and regulate this flow. When humans use linear systems the physical structures still perform these functions to some extent but the linear form systems become important as indicators of routes to a series of locations. This principle of imparting information about desired routes may be termed 'channelling'. The linear form system should be designed to embody this principle by relating its various form components to enable the user to choose the most rewarding routes to any desired locations.

Proposed Measurements of Form Systems

3.3.4.1 Activity seems the basic measure of the working of a form system, areal or linear. It follows that the basic indicator of systemic structure is the activity pattern. The best indicator of activity patterns is deemed to be overall use - how many people actually use a facility with some minimum degree of consistency. Overall use establishes a 'head count' of use free from any measurement bias accorded to special facilities such as schools or lock-ups by particular segments of the population - e.g., school-children or car owners. It does not give measurements of activity intensity, however. For these the study will measure use frequency and use amount. Steinitz found that use frequency - how often a place is visited - is the best indicator of form activity knowledge (3.3.2.4). Use amount - how long a place is visited - is the primary activity measurement which may influence certain form evaluations which are not due to use frequency. These measures of activity may also be judged by their appearance. Steinitz found that appearance of activity may actually influence both knowledge of form and the

influence both knowledge of form and the amount of activity.[1] The combination of identifiable form characteristics, according to Steinitz, results in both "meaningful" knowledge of form and in the degree of complexity of this knowledge.

3.3.4.2 Form components may also be judged in terms of categorical importance: social, cultural, historical and visual. Steinitz found that both activity and form characteristics related to these evaluations.[2] The general measures of importance in the areal systems may be taken as social importance - perhaps the basic measure of the degree of existence of a neighbourhood system (3.3.2.2). In linear systems, which give access to more diverse locations, importance may also be judged in terms of cultural and historic importance - evaluations concerning a much larger population and more specialized destinations than that of the neighbourhood system. Steinitz's work indicates that both types of systems should be evaluated for the correspondence of visual importance to these and other factors.

3.3.4.3 These factors should be measured by how they correspond to the physical structures of the systems. If they are influential in the comprehension of forms then there should be some relationship between them and how the physical system is actually structured. This structure may be judged in terms of the accessibility and visibility of its component parts. Finally, the measures of activity, apparent activity, importance and physical structure may be tested for their

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1 Steinitz, op. cit., p.246.

2 Ibid., p.240.

agreement with the general appeal of the system.

3.3.4.4 Certain 'in place' characteristics may have implications for systemic structuring and use. For areal systems these are presumed to be certain spatial characteristics (A. 2.1.1, A.2.2.1, Map A.2.1). Those selected for initial study should be space-defining characteristics such as building height and types, which form the 'frame' of a space and ground slope, which forms the 'floor' of a space. The size of the space would also be important, particularly in built-up urban areas where open space may be at a premium. Materials and colours which are necessary for the perception of form may also be important in space definition. For linear systems the identity of destinations from the travel route and the identity of the destination entrances may both be important (3.3.3.3, 3.5.2). These would seem to fulfil the functions of place identification, to orientate the traveller and to provide identification of the place where he should leave the linear system and enter the areal system or change to a linear sub-system. This may be more important in road travel since this system's relative containment and higher speeds call for quicker, more positive entrance identification.

Summary - Hypothesis 2

3.3.5.1 Although physical structures may be considered systems, it is only when they satisfactorily expedite human activities that they function in a systemic capacity and their forms have systemic significance. However, when the physical system does not fulfil its activity obligations the activity pattern "with its subtler distinctions" will still organize forms into one of the two basic systemic patterns - areal or linear. This study will examine two linear

systems, vehicular and pedestrian, and one areal system, the neighbourhood. The neighbourhood forms should locate and identify the locus and extent of localized, grouped activities. The neighbourhood may have a somewhat felxible size depending on the activities and purpose of the unit. The forms of the unit are usually structured corresponding to the activity pattern. They tend to be smaller and more complex than the more formalized units heretofore designed but have boundaries and structure highly coincident with physical features and should comprise 'thematic units'. Forms of linear systems are to direct and contain extended flow activities. Road systems do this to a great extent but, aside from peak flows, there is evidence that the majority of trips for all persons of all ages are made by transit and on foot. Pedestrian forms, in fact, give the user a much more thorough knowledge of environmental structure and activity but road forms can be made to perform this function. Linear form systems should impart information about the most rewarding routes to a series of desired locations in order to 'channel' the user to these locations.

3.3.5.2 Generally, areal activity seems to determine the 'thematic' areal form structure while linear form structure determines or 'channels' linear activity. Both areal and linear activities may be measured by overall use, use frequency and use amount to determine their systemic patterns. The appearance of activity may relate the knowledge of form to this activity. The importance of the component parts of the systems should also relate to these activity factors. The structure of the system in terms of accessibility, visibility and the 'in place' characteristics of the component parts should relate to the activities of the system and the structuring of the

resultant form complexes. The various factors influencing form systems should be judged in terms of their resultant appeal.

Hypothesis 3: Form systems have characteristics which are visually identifiable.

3.4.0 Reasons have been put forward why the physical form of the environment may be of a systemic nature and why these activity based systems are of two types, areal and linear. But forms, to work as a system, must be visually identifiable. By the definitions of a system this means that the constituent parts of form complexes must have structured visual relationships. Either some or all of the form characteristics must be related in ways that are visually identifiable to the observer.

Implications of Previous Form Studies

3.4.1.1 Steinitz's study indicated that activity characteristics are sometimes more important to place identification than form characteristics. He suggested that activity characteristics could be defined visually as well as statistically.[1] In other words the appearance of how often the characteristics occurred was assessed as well as how often they did occur. Activity was measured by frequency of destination and amount of use while respondents were asked about the apparent busy-ness of specific use areas.[2] Steinitz treated form characteristics in the same way. He used form type,

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1 Ibid., pp.236-240.

2 Steinitz directly related these to some fairly standard use categories such as agriculture, fishing, mining, private households, hotels...utilities...services and so on. (This information is taken from Steinitz's "Type Congruence, Matrix Analysis" supplies along with various other information in a letter to the writer dated 9 December, 1968.)

intensity and significance based on certain form indicators such as signs, building concentrations and uses of premises, measuring these first by fairly straightforward counts for statistical critera and then by respondents' reactions to questions keyed to these criteria.[1] While most of these criteria are obviously valid for the visual assessment of single forms and in some cases single areas they were primarily chosen because they were specific form characteristics and thus could be directly related to activity characteristics for the purpose of assessing congruence between activity and form.

3.4.1.2 Lynch also proposed form characteristics or 'qualities' from the findings of his analysis.[2] These characteristics seem to fall into three broad categories: first, those concerned with single elements such as simplicity, singularity, names and meaning; second, those concerned with groups of elements such as dominance, clarity of joint, visual scope; third, those concerned with moving through elements such as continuity, directional difference, motion awareness and time series. It may be noticed that the categories are 'permissive' - the qualities of the first group can be applied to both the second and third groups and those of the second to the third group.[3]

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1 Steinitz, op. cit., p.240.

2 Lynch, op. cit., pp.105-108.

3 Terms like 'simplicity' and 'singularity' can apply to groups of elements and the effects of movement through elements as well. Terms like 'dominance' and 'clarity of joint' can also apply to the effects of movement. But dominance and clarity of joint suggest the need for more than one element before they can be assessed. Terms like 'continuity' and 'directional difference' suggest the need for movement through elements before they can be assessed.

3.4.1.3 Steinitz's and Lynch's sets of form characteristics are both useful for the visual assessment of forms. There are areas of similarity between the two, but neither set would be adequate for evaluating form systems. Steinitz and Lynch each had specific goals in mind in doing their studies. Their methods of evaluation were conditioned by what they wanted to find out. Lynch was primarily interested in discovering how a total image was observed. To this end his form characteristics were derived from his investigation and tend to describe qualities necessary for perceiving this assembled image, not the characteristics used in putting the image together. Steinitz was primarily interested in discovering the relationship between form and activity. He therefore directly related his form characteristics to corresponding activity characteristics. Although some of his chosen characteristics, such as construction type, height and views could be used for a form systems assessment, most are fairly detailed measurements for the purposes of building up single form/activity images.

3.4.1.4 The findings of the two studies differed in at least one important respect. Lynch had suggested five basic categories of form elements, paths, edges, landmarks, nodes and districts[1] which he found fitted the types of descriptions used by his interview sample. He found that paths were both the predominant elements and the ones used most often to form other images.[2] Lynch was interested in how these elements were used in perceiving the total urban

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1 Lynch, op. cit., pp.46-83.

2 Ibid., pp.49-83, 91-104.

form. The nature of his survey and questions were concerned with trips and his final conclusion was that the image of the city could best be perceived as a sequence of forms arranged along a path.[1] Steinitz used Lynch's form elements in his study but found that the predominant element was the area.[2] Steinitz's study, however, was primarily concerned with districts or places.[3] His final conclusion was that the congruence of form and activity of places should be made more apparent and comprehensible. Lynch's study was primarily concerned with linear form analysis,Steinitz's with areal form analysis.[4]

Form Relationships

3.4.2.1 The evaluation of form relationships are noticeably missing in both the Steinitz and Lynch studies. Steinitz suggests that using a survey such as his could lead to the formulation of meaning patterns and that "once meaning patterns are established, they can be compared with meaning goals, both for specific places and overall areas".[5] Yet there can also be goals for the inter-relationships of places and areas and one must also know something of the characteristics of the meaning patterns. Lynch recognized

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1 Ibid., pp.141-2, 155.

2 Steinitz, op. cit., p.244.

3 Ibid., p.246.

4 It should be pointed out that much of the evidence put forward by Steinitz supported the image of Boston as analysed by Lynch. Lynch had only surmised that activity played a large part in determining an individual's comprehension of form. In fact, as Steinitz points out, there are striking similarities between his form/activity maps of central Boston and Lynch's image map of the same area.

5 Steinitz, op. cit., p.246.

this in his earlier study when he proposed a more 'dynamic' method of comprehending the larger scale image than its organization by places and areas.[1] But Lynch was bothered about his survey results regarding interrelationships of separate elements. "Only to a lesser extent, unfortunately, did the work make revelations about the interrelationship between elements, or about image levels, image qualities or the development of the image".[2] Thus in both studies the characteristics of form relationships which could have led to an assessment of form systems was lacking.

3.4.2.2 Although Lynch's study stopped short of investigating form systems, he did offer an opinion on the nature of element relationships. First, he mentioned that form elements or groups can be unrelated.[3] Here he is talking of a characteristic which is antithetical to the idea of form systems. Non-relation would be evident, however, as discontinuities in the system or as elements unimportant to the working of the system. It could be the result of observers' inability or disinterest in the forms, of underexposure or of isolation from the system but it is not characteristic of the working of forms as systems.[4] In his discussion of hierarchical relationships Lynch says that "for some their images were organized rather instantaneously as series of wholes and parts descending from

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1 Lynch, op. cit., pp.89-90, 108-115.

2 Ibid., p.49. (Underlining added)

3 Ibid., pp.88-9.

4 Ibid., pp.20-5. Lynch found many discontinuities in his image survey for various reasons.

the general to the particular".[1] He gives an example of someone wishing to go from one element to another and considering that the second element was in a larger unit. They would proceed to the larger unit first and then to the particular element within that unit. Finally, he noted that elements could be related in a more dynamic way - as a continuous sequence of elements such as by driving along a highway.[2]

3.4.2.3 It is interesting that Lynch saw these image characteristics as relating to particular types of form systems. He clearly relates hierarchy to areal organization and continuity to linear organization. As descriptive as Lynch's relationship characteristics are in his analysis of form image they seem inadequate for describing and assessing the working of form systems for several reasons. First, both hierarchic and continuous relationships can be found in either areal or linear form systems. Continuous connections among elements in an areal system such as a number of similar materials used in distinctively individual forms provide a feeling of 'homogeneity' throughout the area. Hierarchic relationships in a linear system, such as the increasing density or size of elements as one approaches a centre, would give the observer a sense of direction and progression along a path. Second, as Steinitz has shown with relation to areal forms, the activity of an element often takes precedence over its form for the user or observer. This means that while the relationships among elements

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1 Lynch, op. cit., pp.89-90, 108-115.

2 Ibid., pp.89-90.

or groups of elements with regard to form characteristics may be either hierarchic or continuous these might change with regard to the activities associated with the elements. Finally, the two characteristics which Lynch proposes do not seem to be complete for while they take account of individual relationships among elements they do not seem to take account of groups of forms or form systems which overlap, either physically or visually. In this case an element or a group may take on meaning above that which would normally be accorded it as a single element, as part of a group of elements or even as part of one or more systems. Consequently, form system characteristics are proposed which seem to allow for these relationships and their structuring by inhabitants.

3.4.2.4 Interlocking connections[1] are between two or more units[2] which are equal in form meaning.[3] The units have the same impact on the observer. In numerical terms this would be called a 1:1 relationship.[4] Areal interlock may be termed homogeneity since it primarily identifies those elements common to an area. These are form elements which, by their visual characteristics, tend to identify the thematic unity of the area. Linear interlock may be termed continuity since it primarily identifies those elements which are constant along a path. These are form elements which by their visual characteristics

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1 The word 'connection' is used here in place of relationship since it seems more denotive of a single physical relationship.

2 The word 'units' denotes both single forms and form complexes.

3 The word 'meaning' denotes the combined assessment of form and activity characteristics.

4 The characteristics of non-relationship or non-connection that Lynch cites (3.4.3.3) might be numerically expressed as 1:0.

tend to identify the location of channelling characteristics of the path.

3.4.2.5 This relationship can be between some or all form characteristics, such as size, shape, colour or materials. For example, in a street of row houses (which could be both an areal and linear system)[1] each house as a separate unit tends to have an interlocking form relationship with every other house because they are all similar in form. Each house is the same size and shape and usually has approximately the same colouring, materials and other detailing. In a small residential area where there are no prominent locations - for example on a relatively flat site along a straight street - this relationship would be emphasized even more. (Each unit may also have an interlocking activity relationship since the type of activity for all units tends to be the same.) These houses (the form elements) would both identify the unity of the area and the continuity along the street.

3.4.2.6 Hierarchic connections are between two or more units which are unequal in form meaning. In numerical terms this may be expressed as any relationship which is not 1:1. Both areal hierarchy and linear hierarchy primarily identify structuring within the system. Hierarchy is any graded relationship. In areal systems it would structure the channelling of the path. Both systems would have some elements and form characteristics which are more dominant and others which are more subordinate. They may correspond to the use, apparent use, importance or appeal of the system.

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[1] See, for example, Jane Jacobs, The Death and Life of Great American Cities. Pelican, 1964, pp.39-98.

3.4.2.7 In the example of the street of row houses, this time with a church, the form characteristics of each house are subordinate to those of the church, and therefore the relationship between each house and the church is hierarchic rather than interlocking. Even if many of the activity characteristics of the church, such as the frequency and amount of use,are considered subordinate to those of the houses the significance of church activity and the probable dominance of its form characteristics will reinforce the hierarchic connections. (The symbolic significance of the church 'as a church' may also predominate where the form characteristics do not.)

3.4.2.8 Overlapping connections are the result of two units acting together or one unit being part of two or more complexes and, consequently, accumulating form meaning. They may be interlocking but, due to their cumulative effect, are usually hierarchic. Both areal and linear overlaps primarily identify the structural joining between or among systemic elements within a system or between or among different systems. These occur at linear crossing (junctions or gates) or at areal overlaps and merges.

3.4.2.9 In the example, if the street of row houses crosses another street of row houses the junction takes on an added importance. It is a component of each linear system and, in addition, achieves an added importance as a possible interchange between the two. The houses of each area may be a different colour, thus accentuating the overlap, but may be of the same height and type, thus providing homogeneity between the two areas. If the church is on the corner both hierarchy and overlap are accentuated. Overlap may

be purely visual. If an areal node or focus is seen from a linear system when the area is not visible it forms an overlapping (i.e., connecting) feature between the two systems.

Summary - Hypothesis 3

3.4.3 Both Steinitz and Lynch proposed certain sets of identifiable form characteristics. Steinitz's were related more to areal considerations and Lynch's to linear considerations, but neither set dealt with systemic form characteristics of relationships among forms. If the form of the environment is of a systemic nature and these systems are activity based and oriented then the relationships among areal forms and linear forms should be visually identifiable. The visual characteristics of form systems are hypothesized to be: interlock - the homogeneity of areal elements and the continuity of linear elements; hierarchy - the grading of both areal and linear elements; overlap - the cumulative effects of crossing linear elements or merging areal elements.

Hypothesis 4: The systemic structuring of form elements results in a more useful and edifying urban environment.

3.5.0 The forms of the separate parts of systems are governed both by their individual purpose and their purpose within the system. It is not always evident which purpose is more influential so the form may be more or less related to the form system. The theory of systems which has influenced planning was developed from a need to completely break down or analyse all the functions of every part of a system.[1] This approach to systems analysis with regard to bio-

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[1] Geoffrey Broadbent, "A Plain Man's Guide to Systematic Design Methods", Journal of the Royal Institute of British Architects. May, 1968, pp.223, 224.

logical and ecological systems is used to understand the sum of the working of each part to project the working of the entire system.[1] Significantly, the analytical approach to planning was first seriously questioned by Geddes whose 'thinking machine' diagram was as much for seeing the total purpose of the environmental system as for seeing how the individual parts fitted together.[2] [In the example of the mechanical system (3.2.2.1) the individual purposes of the parts were to regulate, measure and speed the flow of water. The systemic purpose of any individual part is to carry water. The purpose of the entire system, however, is to carry water in the most efficient way possible.] It is total systemic function or purpose that most relates the individual parts of a physical system, especially those of mechanical/human and human systems. It is proposed that form systems must ultimately be judged in terms of their usefulness and edification for the human user[3] as their total or overall purpose.

3.5.1 Lynch and Steinitz are both reasonably specific about the reasons that more highly structured and visually identifiable environmental forms are necessary. Lynch begins his study by making fairly extensive references to the need of both primitive and modern societies for this type of environment.[4] He points out that at least one aspect of form organization, orientation, "is fundamental

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1 Davy, op. cit., pp.10, 12.

2 Patrick Geddes, Cities in Evolution. London: Williams and Norgate Ltd., 1949, pp.194-205. Also see John Davy, "Do we or Don't we Understand the Secret of Life?", Observer Magazine. 15 February, 1970, pp.17-20.

3 Lee, op. cit., pp.172-173.

to the efficiency and to the very survival of free-moving life".[1] Lynch specifically concentrated on "the mental image of that city which is held by its citizens".[2] Perhaps for this reason he finds that structure and visual identity "seem to play a social, psychological and aesthetic, as well as a practical, part in our lives".[3] He lists consequences such as ease of movement, organization of activity, belief and knowledge, symbols and memories of group communications, emotional security, depth and intensity of human experience, and symbolism of complex societal structure as some of the attributes of highly visible forms and form complexes.[4]

3.5.2 Steinitz makes several specific suggestions about how some of these attributes can be accomplished when they relate to the activities of places. In addition to increasing place intensity which relates to individual economic considerations ("a place must look busy to be busy"[5]) he discusses the possibility of a systemic structuring of place significance. He gives as an example the routing of the Central Artery in Boston on the basis of traffic considerations. There has been a recent shift of important activity types to positions where they are both visible from the new road and accessible to it. Steinitz surmises:

> If the criteria by which the original route was selected had emphasized visual values - for example if it had exposed more of Boston's important places

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1 Ibid., p.3.

2 Ibid., p.2.

3 Ibid., p.123.

4 Ibid., pp.4, 5.

5 Steinitz, op. cit., p.246.

> - many of these recent shifts might not have been necessary. And even if, after weighing visual goals with the many others which influence highway route selection, the existing alignment was judged the best one, far more consideration should have been given to the influence of the resultant exposure pattern. For example, plans for the Government Centre might not have sighted a motel which will block much of the potential exposure of the new City Hall, and the waterfront redevelopment area might not have been designed so that its major public activity, the aquarium, will be largely unseen.[1]

Steinitz suggests that, in practical terms, the total social and economic consequences of these shifts and other disruptions may greatly outweigh the savings of the 'least costly' route originally selected.[2]

3.5.3 If the findings of Lynch and Steinitz are accepted it is clear that the visual structuring of forms can result in the physical environment being more useful and edifying. However, this study is primarily concerned with the relationships of forms as identifying the working of systems. This is something that Steinitz superficially examined and Lynch hypothesized from his findings. In summarizing these two investigations it could be said that Lynch was interested in the comprehension of the total physical environment and that he investigated the elements which formed this comprehension. He found that the elements could be classified under broad categories by both trained observers and everyday users and that there were, prima facie, certain patterns and discontinuities

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[1] Ibid., pp.247-8, footnote 17. This argument involving the siting of the Central Artery by visual as well as other criteria is treated more extensively by Appleyard, Myer and Lynch in The View from the Road. (op. cit.)

[2] Ibid., pp.247-248.

evident among these categories which helped or hindered comprehension. He then suggested ways in which this comprehension seemed to be formed and, after briefly discussing the seeming advantages and disadvantages of each, he chose one which he thought would best connect the elements to give a comprehension of the total urban physical environment.[1]

3.5.4 Steinitz investigated what made the elements important in terms of form and activity and how this importance rated the element categories suggested by Lynch. He then suggested ways by which the impact of individual elements or groups of elements could be increased to emphasize their meanings and to help the total comprehension of parts of the physical environment.[2] What neither Lynch nor Steinitz investigated fully was how these elements were put together by the assessment of the form relationships and how these related to factors such as activity, apparent activity, importance, structure and appeal. Since their investigations did not take this into account they only incidentally examined how these relationships could be important to the inhabitants.

3.5.5 There are a number of sources which suggest that the perception of environmental form relationships is important for

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1 Lynch suggested from his findings that there were four basic types of interrelationships - 'free', 'positional', 'flexible', and 'multiple'. From free to multiple these were graded by their increasing degree of knowledge complexity. Although this suggests varying needs for amounts of knowledge about the form of the physical environment, Lynch does not relate these to general age/sex groups, socio-economic classes or specific types of forms and spaces, because his survey did not yield this type of information. Op. cit., pp.88-9.

2 Steinitz, op. cit., pp.245-48.

these purposes.[1] In addition to the sources already cited in Chapter II and elsewhere in this study two statements suggest the importance of form system comprehension. On areal systems Gutman writes:

> Social communication relies upon the use of the senses, the human faculties of receiving mental impressions through the bodily organs and through the awareness of changes in bodily states. Site plans acquire some of their significance from their capacity to facilitate or thwart the use of the senses; in other words, through their power to regulate the communication process (underlining added) among the residents and other users of the plan area.[2]

and on the relationship of areal and linear systems Lee notes that:

> Continual change and refinement are brought about by interaction with the environment. The human being tries always to introduce order, to "make sense" of experience and this involves usually a gradual but sometimes quite sudden growth of (socio-spatial) schemata as two hitherto disconnected areas, physical or social, are joined together to give a whole new lot of connections and possibilities of navigation.[3]

Summary - Hypothesis 4

3.5.6 The overall systemic purpose of form systems should be to make the environment more useful and edifying for the inhabitant.

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1 See, for instance, Amos Rapoport and Robert E. Kantor, "Complexity and Ambiguity in Environmental Design", Journal of the American Institute of Planners. July, 1967, pp.210-221; Michelson, op. cit., pp.106, 108. There may also be disadvantages in form systems. Lynch points out that there are disadvantages in imageability (op. cit., pp.138-9) and Steinitz, in a letter to the author dated 9 Dec., 1968 comments, "Some important activities are never congruent with form. The Mafia headquarters is a good example. Some are important because they can be anonymous. In general, congruence (of form and activity) is a sound goal - but it won't always be possible or desirable."

2 Gutman, op. cit., p.165.

3 Lee, "The Conception of Space and Control of Environment", op. cit., p.175.

It is proposed that if the relationships of forms are systemically structured then thematic units of areal activities and channelling of linear activities can result in a more useful environment. The studies and sources examined suggest that the structures of individual forms and form complexes are highly important to the comprehension of the environment and several sources imply that systemically structured and perceived environmental form is the method by which overall systemic purpose is achieved.

Summary - Chapter III

3.6 This study will attempt to determine if the forms of the environment are of a systemic nature, and if these systems are basically areal and linear. It will further attempt to determine if the inhabitants comprehend basic visual relationships characterized by interlock, hierarchy and overlap of form complexes. Finally, it will attempt to examine some of the implications of this systemic structuring - or the lack of it - for the activities and edification of the inhabitants.

CHAPTER IV

4.0 In order to test the form system hypotheses in the previous chapter it was decided to select one or more new towns for case study. Lynch had indicated that further visual structuring investigation should be carried out in "very new and very old cities".[1] A preliminary analysis of existing new towns was carried out by the writer in early 1967 to determine which towns would be the best subjects for such a study (Table A.1.1). This analysis later formed a basis for the selection of Cumbernauld. The rationale for that selection follows.

Limitations

4.1.1 The first limitation imposed on the selection of subjects was that the towns should be physically developed enough that an examination of their forms would yield valid and viable results. The percentage of the ultimate population growth since designation was taken as a general measure of this development. Examination showed that only new towns having at least 25% of their population growth also had a corresponding physical growth sufficient for analysis. An examination of Table A.1.2 shows that only the first fifteen new towns designated fulfilled this requirement.

4.1.2 The second limitation was to narrow the choice to a small number of towns which could be investigated within the resources of the writer. Three towns, Crawley, Newton Aycliffe and Cumbernauld, were selected as probable case studies (Appendix 1). Due to a limitation of finances and the rather involved and untried nature of the testing procedures employed it was necessary to restrict the

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[1] Kevin Lynch, The Image of the City. Cambridge, Mass.: The M.I.T. Press, 1960, p. 156.

study to only one of these three towns.

4.1.3 Cumbernauld was chosen primarily for two reasons. First, it was convenient to the writer's place of study. This meant savings in time and travel, a greater amount of control over any survey work done, more frequent and lengthier contacts with all individuals concerned with the survey and a better opportunity to check results 'on the ground'.[1] Second, it seemed from preliminary investigation that Cumbernauld was the most atypical of the first fifteen towns designated. This atypical aspect can have both advantages and disadvantages for case study. For this reason it is desirable to examine Cumbernauld in relation to all of the first new towns selected to find out how it is atypical.

General Physical Characteristics

4.2.1 Cumbernauld was designated in 1955, some five years after the last of the fourteen post-war new towns[2] (Table A.1.3). Since it is fairly new in this respect it had the smallest overall population[other than those of the two provincial, non-overspill new towns, Newton Aycliffe and Peterlee (Table A.1.4)]. It has also had an unusually high population growth. From 1958 to 1967 it grew nearly four times as much as the next fastest-growing town (Table A.1.5). In terms of projected population it was about 32% complete at

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1 At the time of initial requests to the new town development corporations for general information the response from Cumbernauld was the most enthusiastic and cooperative.

2 The post-war new towns are termed 'Mark I', Cumbernauld,'Mark II' and so on. For a discussion of this terminology see Hugh Wilson, "New Town Design-Cumbernauld and After" Journal of the Royal Institute of British Architects. May, 1964, pp.201, 202, 205.

the time of this study.

4.2.2 The site and climate are also unusual. Most of the previous new towns were located in lowlands and valleys or on plateaux. Cumbernauld is built on a series of high ridges and narrow valleys. At this particular location in the north of Britain the sun angle and azimuth are small, wind speed is high and the maximum and minimum (design) temperatures are relatively low (Table A.1.6).

4.2.3 The image of Cumbernauld begins to emerge as a rapidly growing new town with a site and climate which are unusual relative to those of the earlier new towns. To gain a better idea of the difference in planned physical characteristics, however, it is necessary to examine the ultimate size and the distribution of land uses. At first there seems to be nothing unusual about Cumbernauld's proposed size. Both the ultimate population and the designated area are close to median and mean averages for all fifteen towns (Tables A.1.7, A.1.8). Nor, as one would suspect from these figures, does it have a particularly high overall population density (Table A.1.9). There is, however, a distinct difference in what Best terms the 'total urban area'-- that portion of the designated area which is built upon.[1] Cumbernauld has taken a relatively small part of its designated area for this built up development (Table A.1.10) leaving well over 50% of the designated area in external open space. This results in a much higher population density for the total urban area than the average of the first fifteen towns as a whole (Table A.1.11).

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[1] Robin H. Best, Land for New Towns. London: Town and Country Planning Association, 1964, p.16.

4.2.4 A breakdown of land use within the total urban area shows that Cumbernauld has over 30% of this area in open space, the second highest of all the towns[1] (Table A.1.12). This acts to raise the population density in the built up area even higher. In percentages of land in residual uses (12.2%) and educational uses (6.8%) Cumbernauld is effectively average (Tables A.1.13, A.1.14). It is when the figures for industry and housing are examined that an idea of the town's unique form comes into sharper focus. Cumbernauld's industry takes up more of the total urban area (18.4%) than that of any previous new town. Correspondingly, its percentage of the area in housing (31.4%) is the lowest (Tables A.1.15, A.1.16).

4.2.5 A much clearer picture of Cumbernauld's physical form now emerges in relation to that of the other new towns. It has an unusual climate and topography, but is fairly typical in terms of ultimate population, size of designated area and, consequently, gross population density. Most of the site, however, is given over to open space within and without the total urban area. Of the remaining space the relative amounts in residual and educational uses are average, but industrial use has the highest, and housing the lowest, percentage of land of all the first new towns.

Housing Densities

4.3.1 In order to examine housing in detail one of Cumbernauld's most controversial statistics was extracted from those of the first

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[1] Ibid. Best notes that Peterlee, with the highest percentage of open space, benefits from the inclusion of a single large open area within the total urban area. (pp.21-22.)

new towns. The average overall net housing density of the first fourteen towns is 36.9 persons per acre (91.2 persons per hectare). The corresponding figure for Cumbernauld is 85.5 persons per acre (210.5 persons per hectare) resulting from the average ultimate population and the relatively small allocation for housing area. However, if the Cumbernauld figure is compared with the corresponding average for five of the six new towns which have been designated since, its influence becomes more obvious.[1] The average overall net housing density for the new towns designated from 1961 to 1964 is 55.5 persons per acre (137.0 persons per hectare). This is an increase of 52% in the average net housing density between pre-Cumbernauld and five of the post-Cumbernauld new towns (Figure 4.1, p.110).[2]

4.3.2 Available overall net housing density figures for some of the new cities which have been designated or proposed for designation show a possible downward trend.[3] Peterborough will have an overall net housing density of 48.0 persons per acre (118.8 persons per hectare). The figure for the Central Lancashire proposal is 45.0 persons per acre (111.1 persons per hectare). Finally, the newest town designated, Milton Keynes, will have 32.5 persons per acre (80.4 persons per hectare), a figure which is below the average of the first fourteen towns (Figure 4.1, p. 110).

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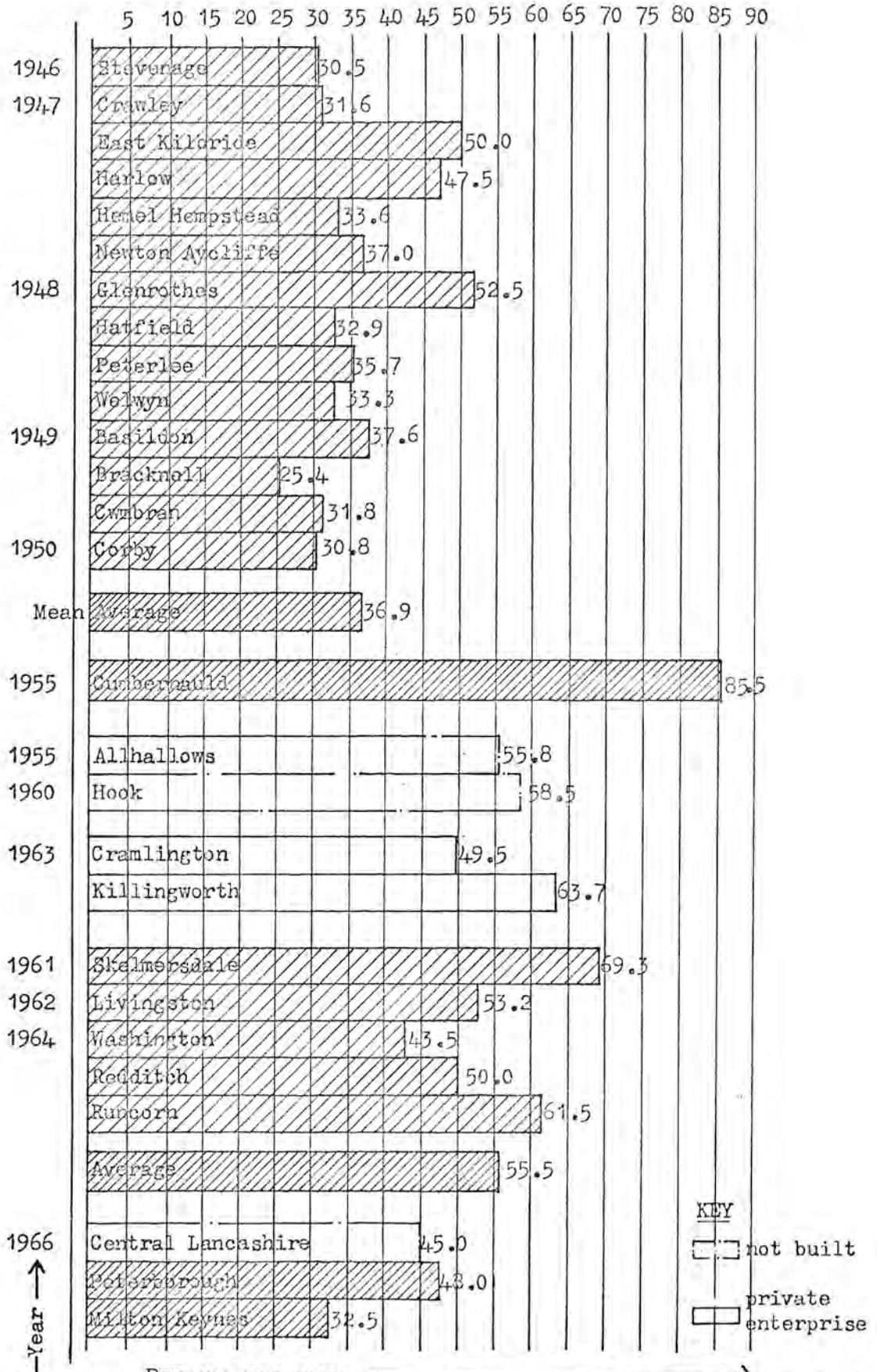
1 The figure for Dawley, designated in 1963, is not readily available. Dawley has since been increased in area and ultimate population and renamed Telford.

2 Figures are also given for Allhallows and Hook, two towns which were proposed but never built, and Cramlington and Killingworth, two private enterprise new towns for the Tyneside Conurbation which are now administered under the 1952 Town Expansion Act.

3 Figures are not readily available for Telford, Warrington (1968), Newton (1967), Northampton (1968), and Irving (1966) which prohibits drawing anything but tentative conclusions from the above figures.



Note: Multiply by 2.47 for persons/hectare.

Sources: Land for New Towns. p.58; Ministry of Housing and Local Government; Cwmbran Development Corporation; "Sociological Aspects of Urban Structure", p.298.

Figure 4.1

Average Overall Net Housing Densities of British New Towns

4.3.3 There is a significant difference, however, between these lower densities and those of the first new towns. The post-war towns had extremely even housing densities over the whole town.[1] In the latest proposals with detailed plans or housing densities published there are a range of densities varying widely from place to place within the designated area. This was partially forecast by the range of housing densities planned for Cumbernauld (Map A.2.5, Table A.2.8) and for some of the later new towns. Livingston, for example, with an overall net housing density of 53.2 persons per acre (131.4 persons per hectare) has planning proposals for accommodating approximately one quarter of the population at densities of up to 200 persons per acre (495 persons per hectare) in the central area.[2]

4.3.4 Even if the overall housing densities of future new towns are closer to the Milton Keynes figure there are strong indications that planning for this range of densities will continue. The idea of planning different densities of development would be in keeping with the newest proposals for increased flexibility in the economic, social and phasing aspects of new communities. This flexibility is the basis for the general groups of density ranges proposed in the South Hampshire Study: 1) 10-50 ppa, 2) 70-120 ppa, 3) 120-300 ppa.* This study outlines the various social, economic and technical advantages of each of these groups.[3] The percentages and physical groupings of these densities could then be arranged to give the best

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1 Osborn & Whittick, The New Towns - The Answer to Megalopolis. pp.152-303.

2 "Livingston New Town - The Master Plan Examined", The Architects' Journal. 14 April, 1965, p.864.

3 Buchanan and Partners, The South Hampshire Study. Supplementary Vol. 2, London: H.M.S.O., pp.72-81.

* ppa - persons per acre (24.7-123.5, 173.0-283.3, 283.3-741.0 persons per hectare)

combiration of advantage for the town and an increased awareness of the disadvantages. Recent developments in high-density/low-rise design may emphasize an increased desire for this variation among inhabitants.[1] Thus, although the overall net housing densities of new communities may drop, there is still likely to be a substantial demand for high density development of the Cumbernauld type.

Detailed Physical Characteristics

4.4.0 The major innovations of Cumbernauld, however, can only begin to be measured by the convenient, if somewhat general standards of growth, site conditions, land allocation and housing density. Many ideas in communications networks, housing area arrangement, the central area, and open space are distinctly different from those used in the post-war towns.

4.4.1 Roads - Previous new towns had all used variations of a radial-concentric road system based on fairly low car ownership.[2] This type of road system, first suggested for Cumbernauld, was tested and found to be unsuitable.[3] A new plan based on the assumption of percentages of modal transport splits, 1.4 cars per household by 2010, and the handling of peak traffic flows to and from various major traffic generating areas resulted in a hierarchic system of town,

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1 "Design Criteria", Official Architecture and Planning. March, 1967, pp.344-360; Alec Colierton, "Low Rise - High Density", Northern Archietect. May, 1966, pp.672-674.

2 J.A. Proudlove, "Transport Planning", Town Planning Review. Vol. 39, No.2, July, 1968, pp.87-90.

3 G.P. Crow, "Traffic Planning in Cumbernauld New Town", Traffic Engineering and Control. June, 1961, pp.112-5.

trunk, distributor and local roads.[1] Town, trunk and distributor roads were to join at multi-level interchanges. This was to result in a system of major roads "of near motorway standard", an entirely different concept than that of the earlier new towns[2] (Map A.3.4).

4.4.2 Footpaths - All of the new towns had been planned for pedestrian/vehicular separation. Footpaths connected neighbourhood units, led to the town centre or out to the open country. The Cumbernauld plan emphasized that no footpaths were to be placed on or accessible to the main roads. A completely separate footpath system was planned to facilitate pedestrian movement and to keep pedestrians off the roads - thus permitting a greater degree of safety and freedom of movement in walking and driving. These plans have been upgraded through the various proposals to lay out "the most direct routes possible to give pedestrians access to the major and minor foci".[3] As in the road system there was to be a hierarchy of footpaths with the main ones giving access to both the town centre and open country and determining "the location en route of a variety of social facilities provided within the housing areas."[4] Footpaths in previous towns had usually acted only to connect broad areas. Those in Cumbernauld were to help structure the whole town (Map A.3.5).

4.4.3 Housing - Cumbernauld was designed specifically as a reaction

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1 Cumbernauld Development Corporation, Origin-Destination Survey Procedure as Adopted in the Traffic Forecast for Cumbernauld New Town. Nov., 1962.

2 Wilson, op.cit., p.196.

3 Cumbernauld Development Corporation, Preliminary Planning Proposals--Second Addendum Report, Jan., 1962, pp.22-23.

4 Ibid., p.22.

against the neighbourhood principle of the earlier towns. The view was advanced by the principle designer that "with a medium sized town the neighbourhood unit is not an essential element and indeed, I believe it can have the effect of breaking down the civic and social quality of the town".[1] Instead, the housing was to be organized in three general patterns based on the "need for privacy at high densities" and the "maximum separation of pedestrians and vehicles".[2] Groupings varied from small individual clusters to large interlocking complexes (Map A.3.6, Table A.2.7).

4.4.4 Central Area - The obviation of the neighbourhood unit with its separate sub-centre coincided with more emphasis being put on the town centre. While pedestrian precincts among rows of shops and larger facilities had characterised the central areas of the post-war towns, the centre at Cumbernauld was conceived to be a single structure "under a great ramped deck of housing" involving multi-level development.[3] Serviced from the major town road at ground level the various levels, from the ground up, are for parking, shopping, public and civic facilities, commercial offices, dining and entertainment, and housing. Levels are connected by bridges, ramps, steps, escalators and lifts[4] (Appendix 4 and Map A.3.3).

4.4.5 Open Spaces - It has been determined that open space provisions

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1 Wilson, op.cit., p.192.

2 Ibid., p.196.

3 Ibid., p.197.

4 Hugh Wilson, "Policies for the New Towns", from a paper for the People and Cities Conference, Dec., 1963, pp.8, 11.

at Cumbernauld are relatively much greater than those of the previous new towns, both within and without the total urban area. The disposition of this open space helps to distinguish Cumbernauld even more clearly from its predecessors. An examination of the new town plans shows that Cumbernauld has its open space in a fairly wide band around the built up area without any substantial penetration of that area by open 'wedges' or 'strays'. This is in contrast to the first towns which often had no substantial encircling belt but frequently had penetrating 'wedges' of land.[1] Most of the open space within the built up area in Cumbernauld is taken up by the footpaths and by large, tree-planting areas along the major roads and around the town centre to buffer the large size of these elements. Additionally, the Cumbernauld development proposals state that the peripheral open space "should be formed into a continuous recreational and amenity system"[2] (Map A.3.2).

4.4.6 It can be seen that Cumbernauld has acted as almost a complete break with the previous new towns in both its general design concepts and in details of its physical form. The higher net housing densities of the post-Cumbernauld new towns and the variations in densities of the proposed new cities reflect the influence of Cumbernauld. It is in the more detailed, if less quantifiable aspects of physical form that Cumbernauld seems to have exerted the greatest influence on new ideas. In the rethinking of communications systems, housing layouts, central areas and open space networks the newest

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1 Osburn and Whittick, op.cit., pp.159, 169, 185, 198, 209, 216, 225, 238, 251, 262, 272, 286, 296, 305, 324.

2 C.D.C., Preliminary Planning Proposals. Op.cit., pp.26-7.

communities, both designated and proposed, have been influenced by the Cumbernauld example.[1] Using it as a case study should provide valuable information by which to judge many of these new ideas.

Form Characteristics and the Study Hypotheses

4.5.1 In terms of this study - the terms of urban form - Cumbernauld is particularly significant. The planners have shown themselves to be aware of urban design concepts. There is certainly strong evidence of this awareness in the Cumbernauld plan, an awareness which seems lacking in many of the previous new towns. Whether the town's functions were 'bent' to adapt to a preconceived form or whether Cumbernauld's distinct form is the result of its intended functions is a largely academic, although seemingly popular, argument. Form considerations have played an important part in the planning process since the inception of the plan[2] and these considerations have usually been of the urban form as a whole.[3] This is what makes Cumbernauld such a desirable, albeit unusual, subject for a case study. It can be tested to see how an emphasized urban form 'works'.

4.5.2 The suitability of Cumbernauld as a case study to support or invalidate the hypotheses of this study must be questioned. To determine this the form features of the town were subjected to a

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1 Peter Hall, "The Pattern of Cities to Come", New Society. 10 March, 1966; David R. Godschalk, "Comparative New Community Design", Journal of the American Institute of Planners. November, 1967, pp.371-387; Proudlove, op.cit., pp.91-94.

2 Wilson, "New Town Design - Cumbernauld and After", op.cit., p.191, para. 4; also, "New Towns: What Next?". The Twentieth Century. Autumn, 1962, p.103.

3 C.D.C., Preliminary Planning Proposals. April, 1958, p.34, First Addendum Report. May, 1959, p.12, Second Addendum Report. Jan., 1962, pp.32, 33.

preliminary investigation within the context of the planning proposals (Appendix 3). A brief discussion follows which relates specific form features to each hypothesis proposed.

4.5.3 Hypothesis 1: "The physical form of the environment is of a systemic nature" - The validation of the major hypothesis may depend on the validation of the second and third supporting hypotheses. The physical environment is often designed on a systemic basis. If the visual comprehension of areal and linear systems can be shown to assume the characteristics of form systems, hierarchy, continuity or homogeneity, and overlap, then the systemic nature of the component forms can be validated.

4.5.4 Hypothesis 2: "Form systems are of two general types, areal and linear" - If the existence of areal form systems can be determined in Cumbernauld it would seem to validate their existence in almost any circumstances. Areal form systems have been defined as those which facilitate and centre localised, grouped activities. This would seem contradictory to Cumbernauld's concentration of activities in the town centre, its planned negation of the neighbourhood unit and - more particularly - its policy of stringing potential centres for such local activity out along the major footpaths. Linear systems, however, have been particularly emphasized in the design of the town. Roads and, to a lesser extent, footpaths have received attention in the planning stage. Both are termed 'systems' and by the descriptions of each in the planning proposals it may be assumed that they were finally planned to be such. The advantage they offer is that they may be tested to determine whether they are used as systems, whether they are comprehended as linear form systems, and what the relationships are between these two factors.

Both of these situations should provide an interesting test of this basic hypothesis. Areal systems would have to be both determined and tested in the face of Cumbernauld's planned non-areal form. Linear systems, which are emphasized, provide a good opportunity to test their relationships with the comprehensive use of the systems' concomitant forms.

4.5.5 Hypothesis 3: "Form systems have characteristics which are visually identifiable" - The three general characteristics of a form system, whether areal or linear, have been defined as 'hierarchy', 'continuity' or 'homogeneity', and 'overlap'. If the existence of areal and linear form systems can be established at Cumbernauld then these characteristics should exist to some degree. A test of the degree to which they are visually identifiable should have a direct relationship to the identity of the form system as a whole. Part of Cumbernauld's stated design policy has been to make certain form elements visually prominent. The identity of these and other elements can be tested, their interrelationships studied, and a determination made of the parts they play in the visual structuring of the systems of the town.

4.5.6 Hypothesis 4: "The systemic structuring of form elements results in a more useful and edifying urban environment" - The planning of all new towns involves a conscious attempt to structure the physical environment to make it more useful and edifying for the inhabitants. Cumbernauld in many respects has attempted to carry this structuring to a more advanced degree than that of the earlier new towns. Particular attention has been paid to the road and footpath structures. These may be tested to see how they are comprehended

and to determine how this comprehension - or the lack of it - affects the efficiency of the system in both functional and social terms. Little or no effort has been made to design areal systems. The arrangement of housing and the location of potential local centres have been related to the road and footpath structures. Here it would first be necessary to establish the existence, nature and extent of these systems and then to test the relationships between their comprehension and their usefulness and edification. If the comprehension of the component parts of areal and linear systems can be shown to affect the activities by which these systems are judged to be useful and edifying then the importance of comprehension will be made clear. Cumbernauld has attempted a highly organized structuring of the physical environment. Its effects on the inhabitants of this environment should be major criteria by which to judge this structuring.

Summary

4.6 This study of new town form is limited by two major considerations. First was the need to choose cases with sufficient development for a thorough, on-site investigation. Second was the need to choose a small number of these which would be the most representative of all the new towns. It soon became obvious that the resources of the writer and the involved nature of the testing procedures would limit the choice to only one town. Cumbernauld was chosen because, upon further investigation, it embodies many features which represent a rethinking of earlier new town design ideas. The effects of this rethinking have implications for both post-war and post-Cumbernauld new towns. It offers conditions both sympathetic and adverse to the testing of the study hypotheses, but

in no instance do these conditions guarantee the validation of these hypotheses. Finally, Cumbernauld 'on the ground' is a working model to which the findings of the study may be applied to alter or enforce certain aspects of the physical and social environment.